IRRI International Rice Research Institute | CGIAR | ICRISAT International Crops Research Institute for the Semi-Arid Tropics | MANAGE | CIP International Potato Center | CGIAR | HarvestPlus Better Crops · Better Nutrition

International Conference on

Food & Nutritional Security through Agriculture Ecosystem

1 - 2 February 2024

Compendium of Abstracts

National Institute of Agricultural Extension Management (MANAGE)
(An Autonomous Organization of Ministry of Agriculture & Farmers Welfare, Govt. of India)
Rajendranagar, Hyderabad-500030, Telangana, India
www.manage.gov.in

Food & Nutritional Security through Agriculture Ecosystem

Edited by

Dr. Veenita Kumari
Deputy Director (Gender Studies)
MANAGE, Hyderabad

Dr. Sugandha Munshi
Lead Specialist & Senior Associate Scientist,
Sustainable Impact Platform, IRRI, New Delhi

Dr. Sampriti Baruah
Regional Research Specialist
Asia, CIP, New Delhi

Dr. K. Naresh
Academic Associate, MANAGE, Hyderabad

Dr Shirisha Junuthula
MANAGE Fellow, MANAGE, Hyderabad

Ms. S L Kameswari
Consultant, MANAGE, Hyderabad

Ms. Pragati Shukla
Consultant, MANAGE, Hyderabad

International Conference on "Food & Nutritional Security through Agriculture Ecosystem - Compendium of abstracts

Editors: Dr. Veenita Kumari, Dr. Sugandha Munshi, Dr. Sampriti Baruah, Dr. K.Naresh, Dr. Shirisha Junuthula, Ms.S.L.Kameswari and Ms Pragati Shukla

Edition: 2024.

ISBN: 978-81-19663-91-0

Citation: Veenita Kumari, Sugandha Munshi, Sampriti Baruah, K.Naresh, Shirisha Junuthula, S.L.Kameswari and Pragati Shukla (2024). International Conference on "Food & Nutritional Security through Agriculture Ecosystem - Compendium of abstracts [e-book] Hyderabad: National Institute of Agricultural Extension Management (MANAGE)

In this e-book, the readers will be introduced to many aspects in the pursuit of Sustainable Agriculture Practices for Food Security, we delve into environmentally friendly and sustainable agricultural techniques, aiming to ensure long-term food security. This theme encompasses a wide range of strategies to enhance the resilience of agricultural systems, improve crop yields, and safeguard nutrition for all. To contribute the readers to sail through this wealth of information, this book provides an amalgam of important aspects of Food & Nutritional Security through Agriculture Ecosystem for further reading. Neither the publisher nor the contributors, authors and editors assume any liability for any damage or injury to persons or property from any use of methods, instructions, or ideas contained in the e-book. No part of this publication may be reproduced or transmitted without prior permission of the publisher/editor/authors. Publisher and editor do not give warranty for any error or omissions regarding the materials in this e-book.

Published for Dr.P.Chandra Shekara, Director General, National Institute of Agricultural Extension Management (MANAGE), Hyderabad, India by Dr. Srinivasacharyulu Attaluri, Program Officer, MANAGE and printed at MANAGE, Hyderabad as e-publication.

Dr. P. Chandra Shekara
Director General, MANAGE.

FOREWORD

It is both an honor and a privilege to extend a warm welcome to all participants, dignitaries, and esteemed guests to the International Conference on "Food & Nutritional Security through Agriculture Ecosystem," hosted by the National Institute of Agricultural Extension Management (MANAGE). As the Director General, I am excited about the invaluable discussions that will unfold around key themes such as Agro-ecology and Biodiversity, Climate-Resilient Agriculture, Sustainable Crop Management, Case Studies and Success Stories, Socio-Economic Impacts of Sustainable Agriculture, Policy and Economics of Sustainable Agriculture, and Gender and Food & Nutrition Security.

In a world confronted by complex challenges such as climate change, population growth, and resource constraints, the role of sustainable agricultural practices becomes paramount. The themes of this conference encapsulate the multidimensional approach required to ensure food and nutritional security for all.

Agro-ecology and Bio-diversity are fundamental to sustainable agriculture, and this conference offers a platform to explore innovative ways of integrating these principles into our farming systems.

Climate-Resilient Agriculture is crucial given the challenges posed by climate change. Our aim is to identify adaptive measures and transformative solutions that enhance agricultural resilience.

Sustainable Crop Management is at the heart of our pursuit of food security. Through discussions, we will delve into practical insights and cutting-edge research on sustainable crop practices.

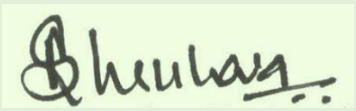
Case Studies and Success Stories provide tangible examples of effective sustainable practices, enriching our discussions and fostering a global community committed to sustainable agriculture.

Socio-Economic Impacts of Sustainable Agriculture will be explored to understand how sustainable practices contribute to livelihoods and economic development.

The Policy and Economics of Sustainable Agriculture are pivotal in shaping global food systems. Engaging policymakers and economists will help develop frameworks that support sustainable practices.

Gender and Food & Nutrition Security highlight the crucial role of women in agriculture. Through dedicated discussions, we aim to address gender disparities and promote inclusivity in our pursuit of food security.

In closing, I express my gratitude to all participants for their unwavering commitment to advancing the cause of sustainable agriculture. Together, let us embark on a journey of collaboration, innovation, and knowledge-sharing that will propel us toward a future where food and nutritional security are not just ideals but tangible realities for communities worldwide.



Sincerely,
(P. Chandra Shekara)
Director General, MANAGE.

ICRISAT INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS

Dr. Jacqueline Hughes,
Director General, ICRISAT

FOREWORD

I am immensely pleased to extend a heartfelt welcome to all participants, esteemed guests, and scholars attending the International Conference on "Food & Nutritional Security through Agricultural Ecosystem." This conference, co-hosted by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), stands as a pivotal convergence of minds committed to addressing the urgent challenges confronting our global food systems.

In the midst of a swiftly expanding global population and the far-reaching impacts of climate change, the imperative for sustainable and resilient agricultural practices has never been more pronounced. The conference themes, encompassing Agroecology and Biodiversity, Climate-Resilient Agriculture, Sustainable Crop Management, Case Studies and Success Stories, Socio-Economic Impacts of Sustainable Agriculture, Policy and Economics of Sustainable Agriculture, and Gender and Food and Nutrition Security, underscore the comprehensive approach required to achieve food and nutritional security.

At the core of sustainable agricultural practices lies Agroecology and Biodiversity. Grasping the intricacies of ecosystems and advocating for biodiversity fosters environmental health and bolsters the resilience of agricultural systems.

Emphasizing these principles allows us to craft strategies promoting enduring sustainability, maintaining the delicate equilibrium between human needs and ecological well-being.

In the face of shifting climate patterns challenging traditional farming methods, Climate- Resilient Agriculture is the need of the hour. Our collective responsibility is to explore and embrace innovative approaches that empower agriculture to thrive amidst climatic uncertainties.

Through the exchange of knowledge and experiences at this conference, our goal is to pinpoint actionable strategies for cultivating resilience within agricultural systems.

Sustainable Crop Management stands as a fundamental pillar in our pursuit of food security. The prudent use of resources, efficient crop rotation, and integrated pest management are indispensable components of sustainable agriculture. In this conference, we aim to delve into best practices and cutting-edge research, guiding us towards a future where crop management is productive and environmentally responsible.

The inclusion of Case Studies and Success Stories imparts a practical dimension to the theoretical frameworks discussed. By sharing experiences from diverse regions and contexts, we gain invaluable insights and can replicate successful models, ensuring that sustainable agriculture becomes a tangible reality.

Recognizing the Socio-Economic Impacts of Sustainable Agriculture is vital for comprehending the broader implications of our efforts. We must assess how sustainable practices contribute to livelihoods, community well-being, and economic development. This conference seeks to facilitate discussions that bridge the gap between agricultural science and the socioeconomic fabric of our societies.

The Policy and Economics of Sustainable Agriculture play a pivotal role in shaping the trajectory of global food systems. By engaging policymakers and economists in the discourse, we can formulate strategies that incentivize and support sustainable practices on a large scale.

Lastly, the critical aspect of Gender and Food & Nutrition Security cannot be overlooked. Women play a central role in agriculture and food systems, and addressing their unique challenges is essential. By promoting gender inclusivity, we ensure that our efforts toward food and nutritional security are equitable and sustainable.

In conclusion, I express my gratitude to all participants for their unwavering commitment to advancing the cause of sustainable agriculture. Through the collaborative efforts of researchers, policymakers, and practitioners, I am confident that this conference will serve as a catalyst for transformative change. Let us collectively strive to create a world where food and nutritional security are not just aspirations but a tangible reality for all.

Jacqueline Hughes

(Jacqueline Hughes)
Director General, ICRISAT.

Ms. Joanna Kane-Potaka
Deputy Director General, Strategy, Engagement & Impact
International Rice Research Institute (IRRI)

FOREWORD

Maintaining food and nutrition security is of prime importance for nations today as we are constantly in the midst of climate change challenges which are directly affecting our agricultural yield and income of the farmers. In this context I would like to extend my heartiest congratulations to National Institute of Agricultural Extension Management (MANAGE) for organizing this international conference on Food and Nutrition Security through Agriculture Ecosystem.

The approach MANAGE is focusing on in this event - knowledge exchange, collaborations and interdisciplinary interconnections - is critical for maximizing and accelerating innovations for positive impacts.

In the past, the green revolution had played an instrumental role in averting global famine and furthering food security. IRRI is humbled to have been able to contribute to the green revolution with the first semi-dwarf rice variety (IR8) that changed agriculture globally.

However, the need of the hour today is even more complex recognizing that as we continue to feed the growing population there is an equally important need to achieve nutrition security and a healthy planet. Additionally, we need to do this in an inclusive way, so no one is left behind. This is challenging and makes it even more important to bring together the different expertise to solve these solutions in unison.

Rice is at the heart of most countries in Asia for food security and political security. It is important to continually challenge ourselves to bring *smarter staples* to the table, including *smarter rice*. This requires continuing to improve productivity and profitability for the farmer, while in unison ensuring healthier staples, and sustainable and regenerative approaches on the natural resources and tackling climate change. This is a huge challenge to take on, i.e. ensuring in unison that we achieve profitable farming, a healthy planet and healthy food, and doing this in an inclusive way empowering women, youth and the marginalized. This is the focus of IRRI when we work on the discovery and scaling of science-based innovations in rice systems across Asia and Africa.

Headquarters:
Patancheru 502 324, Telangana, India
Tel +91 8455683071, Fax +91 8455683074, +91 8455683075
E-mail icrisat-ind@icrisat.org
www.icrisat.org

Through this international conference, MANAGE has undertaken the task of bringing together researchers, agricultural practitioners, government officials, grass-root organizations, farmer representatives, international organizations, and others to one platform for sharing our experiences and learnings.

At this event we need to delve deeper into the partnerships and innovations needed to achieve food and nutrition security through a multidisciplinary approach including - sustainable and regenerative crop management, climate-resilient agriculture, agro-ecology and biodiversity, new areas of artificial intelligence, social economics including gender inclusive approaches, and nutrition and health, and many more areas. I congratulate everyone who has shared their abstracts and time to present at this international conference.

It is important to engage all value chain players and influencers from fork to farm, within this interconnected system. Through this conference we also hope to contribute to policymakers with science-backed insights towards promoting sustainable agriculture in India and around the world with the goal of encouraging meaningful discourse and collaboration that leads to more supportive and effective agricultural policies.

We look forward to strengthening collaborations through this initiative led by MANAGE, to bring our scientific expertise and on-the-ground learnings to the table together with other esteemed colleagues.

(Joanna Kane-Potaka)

***

Dr.Samarendu Mohanty
Asia Regional Director
International Potato Center

FOREWORD

I am pleased to welcome the distinguished delegates of the International Conference on "Food and Nutrition Security through Agricultural Ecosystem" organized by the National Institute of Agricultural Extension Management (MANAGE*). This is a timely event as the world faces rising food and nutrition insecurity due to various emerging issues including climate change and war. The conference themes, covering* Agroecology and Biodiversity, Climate-Resilient Agriculture, Sustainable Crop Management, Policy and Economics of Sustainable Agriculture, and Gender and Food & Nutrition Security, underscore the interdisciplinary approach needed for making the world food and nutrition secured.

As the world population reaches 9 billion in 2037 and add another one billion in 20 years to reach 10 billion by 2057, the cereal equivalent (CE) food demand is projected to reach 10 billion tons in 2030 and 15 billion tons by 2050, i.e., 70 percent increase in food demand by 2050. To achieve this food production target amid growing effects of climate change in the form of rising temperature, more frequent flood and drought and unseasonal rain, the scientific community will have to get its act together to develop climate resilient technologies including varieties and sustainable production practices that will require less land, less water and less fertilizers. In this conference, the experts are expected to discuss cutting edge technologies, environmentally friendly production practices and forward-looking policies that will make agriculture climate proof, gender inclusive and sustainable.

Finally, I would like to express my sincere gratitude to all participants for their commitment and dedication to improving global food and nutrition security.

Samarendu Mohanty

(Samarendu Mohanty)
Asia Regional Director
International Potato Center

Mr. Arun Baral
CEO, Harvest Plus

FOREWORD

In the vast expanse of India's agricultural landscape, where the intertwining challenges of nutritional deficiencies, climate change, growing population, and resource constraints present a complex tapestry, the need for innovative solutions has never been more pressing. As we confront the nutritional challenges that persist in various pockets of our nation, it is evident that a comprehensive approach is required—one that addresses not only the immediate needs but also builds a resilient and sustainable foundation for the future.

The nexus of climate change, population growth, and resource limitations compounds the hurdles in our quest for nutritional security. The urgency to find sustainable solutions is paramount. Along with agroecology and biodiversity which are the fundamentals to sustainable agriculture**, bio-fortification** can help in tackling hidden hunger on a global scale by breeding vitamins and minerals into everyday staple food crops.

Bio-fortification, a pioneering method that involves breeding essential vitamins and minerals into food crops, stands as a beacon of hope in the face of hidden hunger—a global challenge that extends beyond the borders of nations.

In this pursuit, **Harvest Plus** provides technical assistance, strategic guidance, capacity strengthening, and evidence-driven policy engagement support to hundreds of partners worldwide that are active along the full agricultural value chain. **Harvest Plus exemplifies how bio-fortification can be integrated into food systems**, contributing not only to enhanced crop yields but, more importantly, to the nutritional well-being of communities.

As we delve into the nuanced layers of bio-fortification and its role in addressing hidden hunger, it is my distinct pleasure to be part of the **International Conference on 'Food & Nutritional Security through Agriculture Ecosystem'**.

x

This gathering provides a platform to exchange knowledge, share insights, and collectively explore sustainable solutions that can shape the future of agriculture in India and beyond.

It is heartening to witness organizations such as **MANAGE** recognize the transformative potential of bio-fortification as an integral component of sustainable agriculture and has invited us to be part of this conference to share our expertise.

Participating in this conference is an opportunity to deepen my understanding of the complex relationship between agriculture, nutrition, and sustainability. The case studies presented at this event promise to be illuminating, offering valuable perspectives that can inform our collective journey towards a more secure and resilient food systems.

May this conference be a catalyst for transformative conversations and collaborative efforts that resonate far beyond these pages.

Sincerely,
(Arun Baral)
CEO, Harvest Plus

MESSAGE

I extend my heartfelt congratulations to the MANAGE team and its esteemed partners for organizing the upcoming International Conference on "Food & Nutritional Security through Agriculture Ecosystem." This conference holds immense significance as it serves as a platform for global collaboration and knowledge exchange in area of Nutrition Smart Agriculture and Food System Transformation.

(Mr. Ravinder Grover)
Regional Coordinator- Asia,
Harvest Plus

Dr. VIRENDER KUMAR, Ph.D.
Deputy Head
Sustainable Impact Department Research
Leader, Climate-Resilient Farming Systems
Principal Scientist- Weed Science/Systems
Agronomy, International Rice Research
Institute (IRRI) Los Baños, Laguna, Philippines

Message

At the outset, I would like to extend my sincere congratulations to the National Institute of Agricultural Extension Management (MANAGE) for organizing this international conference on Food and Nutrition Security through Agriculture Ecosystem.

In a world where feeding a projected population of 9.1 billion by 2050 will become a pressing necessity, it is crucial that we work together towards ending global hunger while ensuring food and nutritional security for all. With the increasing demand for food, efficiently utilizing natural resources to produce high-quality food becomes crucial for a sustainable Agri- food system. Cross-learning is essential to foster collaborative efforts at all levels, utilizing our energy, knowledge, and innovations toward an inclusive and resilient Agri-food system. In this context, a conducive platform that brings together farmers, implementers, policymakers, scientists, and academicians to exchange ideas, brainstorm scalable solutions, and discuss challenges and opportunities is the need of the hour.

This international conference aims to provide such a platform, where experts from various fields can share their thoughts and experiences, paving the way for a better world free from hunger. I wish all participants and experts the best in their endeavors to create a pathway that will serve humanity by providing "food for all" and "nutrition for all."

I wish the conference a grand success.

(Virender Kumar)
Dated: The Philippines, 24 January 2024

Director,
International Rice Research Institute (IRRI)
SouthAsia Regional Centre (ISARC) NSRTC Campus,
G. T. Road, Collectory Farm, P.O. Industrial Estate,
Varanasi – 221 106, Uttar Pradesh.

MESSAGE

The challenges posed by climate change significantly contribute to the global issues of food insecurity, hunger, malnutrition, and disruptions in agricultural ecosystems. We must collaborateand address these barriers with over three billion people grappling with these challenges.

Embracing resilient agricultural practices like crop diversification, sustainable irrigation, time management, and precision farming can enhance the ability of agricultural systems to withstand climate crises. Such ecosystems will form a strong foundation of sustainable development and contribute to long-term food and nutritional security.

I want to express my sincere congratulations to the National Institute of Agricultural Extension Management (MANAGE) for organizing the international conference on "Food and Nutritional Security through Agriculture Ecosystem" scheduled for February 01-02, 2024. It is an honor for IRRIto join and contribute to this event as one of the knowledge partners.

I am optimistic that this conference will serve as a valuable platform for policymakers, academics, scientists, research scholars, farmers, extension workers, and entrepreneurs to delve into various aspects of scientific achievements, innovations, ongoing research, and future initiatives in agriculture and related fields.

These discussions at this conference will lead to the formulation of new strategies to overcome challenges and ensure food and nutrition security protection for all.

Wishing my best for the success of the conference!!

(Sudhanshu Singh)
January 23, 2024, Varanasi India

TABLE OF CONTENTS

Theme 1: Agro Ecology and Biodiversity

Key note Speaker for Theme 1

Neglected and Underutilized Species for Food and Nutrition Security

Dr. E.D. Israel Oliver King
Director, Biodiversity, M.S.Swaminathan Research Foundation
3rd Cross Road, Institutional Area, Taramani, Chennai 600113
oliverking@mssrf.res.in

Even though we could make exemplary achievements in the field of global food production through Green Revolution, achieving 'Zero Hunger' by 2030 still remain an ambitious target, partly due to excess dependence on just three crops (rice, wheat and maize) while there exist over 5000 crops (FAO 2015, Willis 2017). Crop uniformity and homogenization of agricultural fields are increasing the vulnerability of agriculture in the context of climate change (Padulosi et al, 2019). A sustainable food system demands conservation and sustainable utilization of diversity of existing nutritious plant species, left behind by the Green Revolution. Mainstreaming or bringing back the underutilized nutritious crop plants (or NUS) into the farming system is vital for the sustainability of agriculture and to achieve zero hunger (M.S.Swaminathan, 1996; 2000).

NUS are well adapted to agro-ecological niches and marginal areas, represented by ecotypes or landraces, highly relevant in Indigenous Peoples' societies and embedded with richness in traditional knowledge. NUS mostly relevant only to local consumption and production system. s and multi-functionality and multiple benefits. Many NUS have low competitiveness and characterized by poorly developed or non-existent seed supply systems and value chains and poorly represented in ex situ gene banks.

In order to conserve, the existing crop plants, especially the neglected and under-utilized species, M.S.Swaminathan Research Foundation has initiated community agrobiodiversity conservation programmes in tribal dominated regions in three States – Odissa, Tamil Nadu and Kerala. The NUS include large diversity of roots & tubers, vegetable crops, leafy greens, pulses, millets, and many more, which received less attention from R & D investments for crop improvement or conservation. They exhibit low productivity but gains significance in local food systems and indigenous culture; ability to adapt to hostile environment and climate change; rich in traditional knowledge; and provide multiple benefits to local community (Padulosi et al, 2019)

Teff, (*Eragrostis tef*), Quinoa (*Chenopodium quinoa), Spicy Rocket Plant (Diplotaxis tenuifolia)* were popularized in the recent past. Padulosi et al., 2011, Jessica et al 2019 documented several NUS and its role in improving nutrition in Low and Middle Income countries.

Millets are a classical example of NUS and their marginalization can be reflected in terms of declining area and production of millets across India, but continued to be cultivated and consumed by smallholders inhabiting in marginal environment (Oliver et al 2022). MSSRF has adopted an integrated and participatory approach for the conservation of landraces, promotion of the cultivation and consumption of millets. The multi-pronged strategies are;

- *Documentation of traditional knowledge:* Those associated with cultivation, post-harvest management, processing and culinary methods adopted by the ethnic communities.

- *Participatory technology development for crop yield enhancement*: By facilitating regular interactions between farmers and scientists (linking frontier science with traditional wisdom), location specific, unique and cost effective cultivation practice has been developed, by giving preference to landraces.
- *Community centered Value chain development of nutria-millets*: Tribal women and men are playing vital role in the value chain of nutria-millets through training on value addition, quality standards, packaging, labelling and marketing.
- *Gender sensitised approach in value chain development:* Network of mills/mechanical processing of millets established across millet cultivating areas. Mechanical processing units helped a lot to address the health issues and time poverty of rural women apart from reducing their drudgery.
- *Revival of traditional seed systems and establishment of community seed banks:* Community Seed Banks were also established to strengthen the seed system, where farm women and men become empowered to run the seed bank. Seed Banks cater the seed requirements of local community and ensured the conservation of diverse landraces.
- *Millet Food Exhibitions:* Cultural events for creating awareness about the dietary importance of millets. The objective was to raise local demand for millets for local economic advancement.

Global collective action efforts of **FAO-GFAR**, in 2022 has led to development of Global Manifesto, Asian Manifesto, Global Plan of Action and Community of Practices on Forgotten Foods. This process encourages Collective Action of on forgotten foods that call for Farmer-led co-innovation for transforming agri-food and research systems.

i) **Co-creation:** A co-designed action, allowing thousands of stakeholders (including farmers, researchers, industry, and governments) representing different views and knowledge systems, to collaborate, and mobilize their resources and ingenuity.

ii) A new approach to forgotten foods and neglected underutilised species (FF/NUS): Valorising the contributions of forgotten foods and NUS towards resilience, food security, and improved nutrition. Showcasing pathways for supporting food systems and agroecology transition, building on local knowledge and capacities. A pathway to strengthen farmer-managed seed systems leading to agro-biodiversity conservation and climate adaptation.

iii) Game changer of agricultural innovation and research systems: Mainstreaming and scaling and out farmer-led innovation that will lead to a transformation of research governance and approaches, spearheading new replicable models of partnerships and inclusive processes.

iv) Pro-poor value chain development: Ensuring that through the generation of value, poor smallholder farmers, particularly women, remain in control of the benefits from the development of new business models (e.g. public-private-producer partnership) and incentive mechanisms (financial or non-financial), the creation of new enterprises, and mainstreaming of FF/NUS.

Study of the Floristic Composition and Density of Woody vegetation on farms (Villages: Zoumanadiassa, Touroumadié, Nganassan in Mali's cotton growing zone)

Mamodou

Abstract

The present study was designed to assess the floristic composition and density of woody vegetation in the fields, in order to gain a better understanding of the role of trees in the agrosystem. It was carried out in 3 villages, including Nagnassoni (Commune de Fama), Zoumana-Diassa and Touroumadié (Communes de Kléla), all belonging to the same agro- ecological zone in the Sudanian zone of southern Mali. In each village, an inventory of woody vegetation was carried out in 100 m x 50 m plots usingsystematic one-stage sampling.

In each plot, all woody species were measured at a pre-count diameter of 3 cm at breast height (1.30 cm from the ground). Dendrometric data (diameter at breast height, total tree height, height of first basal branch, average crown diameter) were collected on each tree and/or shrub. The results show that Vitellaria paradoxa and Parkia biglobosa are the dominant species, with 72% and 10% respectively.

These species have an average diameter of 41 cm at 1.30 m from the ground, an average height of 10.4 m and an estimated average age of 123 years. Species from the Fabaceae family are the most represented. The density of shoots is 26 individuals/ha and the main species are Diospyros mespiliformis, Dichrostachys cinerea, Piliostigma reticulatum and Detarium mespiliformis. Across the 3 sites, 70% of trees and shrubs are healthy, 28% are affected and 2% are standing dead. Affected trees and shrubs have mostly been cut back, trunks debarked, branches dried out or, more particularly, karities parasitized by species of the Tapinanthus genus (Loranthaceae).

Keywords: Agro-forestry park, Basal area, Woody vegetation, Floristic diversity, South Mali.

Participatory Plant Breeding: A Novel Approach to Crop Improvement

Noru Raja Sekhar Reddy[1], Beena Thomas[2], Aiswarya Raj P.T [3]
1 & 3 P G student, Department of Genetics and Plant Breeding, College of Agriculture, Vellayani, Kerala Agricultural University, Thiruvananthapuram, Kerala-695522.
2 Assistant Professor, Department of Genetics and Plant Breeding, College of Agriculture, Vellayani, Kerala Agricultural University, Thiruvananthapuram, Kerala-695522.
Email id: rajareddynoru@gmail.com

Abstract

The global community has recently witnessed a growing concern regarding the impact of changing climate patterns on worldwide food security. Fluctuating climate conditions have led to uncertainty in farming practices, resulting in food scarcity and increased global prices. Addressing this critical challenge necessitates the development of novel strategies to achieve the goals of heightened food production effectively and increased resilience in agriculture. Genuine diversity within crop fields is fundamental to realizing these objectives. Participatory Plant Breeding (PPB) is geared toward customizing crop varieties to specific ecological contexts, driven by the interplay between genotype and environment. It encourages collaboration among breeders, farmers, and various stakeholders, addressing diverse interests ranging from food security to health and employment. PPB examines the enduring stability and genetic diversity implications of varieties resulting from its initiatives. Although PPB programs yield diverse classifications based on farmer preferences and local conditions, a more comprehensive understanding of their stability and genetic diversity requires further refinement. Objectives include enhancing crop production profitability and adopting improved, context-specific varieties to benefit targeted user categories while enhancing farmer selection and seed production proficiency. The multidisciplinary activities within PPB, including goal identification, genetic diversity generation, experimental variety selection, evaluation, release promotion, seed production, and women empowerment, collectively drive its potential to revolutionize crop genetics through PPB methodologies. Through this strategic approach, PPB contributes to sustainable crop production in the face of climate change impacts, enhancing crop diversity and alleviating hunger.

Keywords: Climate patterns, food security, Genetic Diversity, Collaborative Breeding, Women Empowerment.

Effect of soil moisture stress on different functional groups of soil microorganisms

M. Manjunath, N. Jyothilakshmi, A. K. Indoria, G. Pratibha, K.A. Gopinath, S. Savitha, Arun Shanker, M. Srinivasa Rao and V.K. Singh

ICAR-Central Research Institute for Dryland Agriculture,
Santoshnagar, Hyderabad – 500 059, Telangana, India.

Abstract

Plants and microorganisms are coevolved over the years. Microorganisms play vital role in managing various biotic and abiotic stresses. Soil moisture stress considerably affects the soil microbial population. An experiment in groundnut (cv. K-9) was conducted under rainout shelter. The objective of the study was to assess the effect of different levels of moisture stress on soil microbial as well as plant growth and physiological parameters. Initial soil physico-chemical parameters such as available NPK and organic carbon contents were 182.37, 15.13, 215.10 kg ha^{-1} and 0.62 %, respectively. The soil was sandy clay loam in texture with a pH of 6.46. The soil moisture content at field capacity and 20 days moisture stress was 22.0% and 4.7 %, respectively. The soil moisture stress was imposed at flowering stage (42 DAS). Culturable soil microbial population such as bacteria, fungi, actinomycetes, free living nitrogen fixing bacteria (NFB) and phosphorus solubilizing bacteria (PSB) was enumerated by using appropriate growth media. The population of free-living nitrogen fixing bacteria decreased significantly with the reduction in soil moisture content from 22.0 % to 4.7 %. Relative water content reduced from 89.73 % to 23.50 % with the depletion in soil moisture content. The plant parameters such as plant biomass, shoot length, number of pods and pod weight were recorded. The plant biomass ranged from 92.50 to 354.50 (g/plant) and decreased with the reduction in soil moisture content.

Keywords: Drought, Groundnut, Plant parameters, Physiological parameters, Soil microorganisms

Underutilized Pigmented Rice varieties - Potential Antidote to Nutritional Security

Aparna Kuna1, Lakshmiprasanna Kata[1], *Naseerunnisa Mohmmed[2], Debjani Das[2], and P.Naresh[1]

Abstract

[1]MFPI - Quality Control Laboratory Prof. Jayashankar Telangana State Agricultural University, EEI Campus, Rajendranagar, Hyderabad, Telangana, India.

[2]Ph.D Scholar, Dept. of Food and Nutrition, Post Graduate and Research Center, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India.

The study was undertaken to understand the nutritional importance of forgotten and underutilized pigmented rice varieties, with the objective of analyzing the nutritional and functional properties of pigmented rice varieties (Brown, Red and Black Rice varieties) which were procured from farmers of Telangana and Tamil Nadu.

Methodology: Twelve different varieties of pigmented rice were taken and classified into (4 Brown, 4 red and 4 black), along with a control sample, and the same were analyzed for nutrient composition, anti-nutrient factors, bio-active components, physical and functional properties using standardized and validated methods.

Results: Our findings revealed that physical qualities such as kernel length, breadth, elongation ratio was found similar in all pigmented and control rice varieties. Color L*, a* and b* values significantly differed among all the varieties. Bulk and tapped density was found in the range of (0.48-0.6 g/ml) and (0.75-0.93 g/ml). Except Kalabathi (black rice) remaining all rice varieties showed gel formation at 12% flour concentration. There was no significant difference observed between functional properties among rice varieties except foaming capacity which was found less in black rice (0.99 %), while water absorption capacity was highest in control (9.12 ml/100g). Protein content was highest in black rice (7.77 to 11.89 g /100 g) and red rice (7.22 to 10.68 g/100g) than brown rice (5.86 to 7.88 g/100gm). Among all the varieties, highest protein (11.89 %), ash (1.84 %) and crude fiber (2.90 %) was observed in black rice. Total Antioxidant activity was found highest in red rice (350.00 µg/100g) followed by brown rice (166.67 mg GAE /100g**)**) and black rice (129.63 mg QE/100 g) than control (54.41 mg QE/100 g). Phenols and flavonoids were significantly higher in pigmented rice varieties when compared to control. Brown rice varieties had medium amylose content (12.73 to 23.89 %) which was ideal for cooking quality and also intermediate gelatinization temperature. Tannins and Saponins were present in negligible amounts.

Conclusion: The results indicate that pigmented rice varieties can be an excellent source of diverse nutrients along with bioactive compounds, which are beneficial in prevention of lifestyle disorders compared to polished rice.

Consumption of pigmented rice varieties can certainly provide nutritional security to people suffering from hidden hunger.

The present study evidenced the presence of significant amounts of antioxidants in pigmented rice varieties with varying physical and functional properties which could be beneficial in preparing tailored made products in food industries, which can supply better nutrition to consumer.

Key words: Underutilized, Pigmented Rice varieties, Potential Antidote, Nutritional Security

Unveiling the Urbanization-Climate Nexus: Geospatial Insights into Land Use Changes and Climate Variables in Odisha's East and South Eastern Coastal Plain Zone

Raina Thomas[1]*, Fawaz Parapurath[2], B. S. Rath[1]

[1]*Odisha University of Agriculture and Technology, Bhubaneswar - 751003, Odisha, India*

[2]*Tamil Nadu Agricultural University, Coimbatore - 641003, Tamil Nadu, India*

***** rainathomas1997@gmail.com

Abstract

Climate change and global warming pose significant environmental challenges, with anthropogenic influences such as emissions and urbanization playing key roles. A number of studies have indicated that there is some relationship between urbanization and climate change because the process of urbanization alters natural surface and atmospheric conditions. So, in this study, the extent of urbanisation over the East and South Eastern Coastal Plain Zone of Odisha, India, was computed to assess the impact on climate variables. For this a detailed Land use land cover (LULC) change detection study was undergone using the geospatial technology, including the computation of Normalized Difference Vegetation Index (NDVI), Normalized Difference Built Up Area Index (NDBI) and Land Surface Temperature (LST) using the Landsat 5, 7 and 8 satellite images. The results revealed a substantial decrease in forest cover (44.11%) and agricultural land (12.6%), coupled with an 84.38% surge in settlements from 2000 to 2020. Therefore, a significant change in land cover was identified during the study period (2000 to 2020) with an overall classification accuracy of more than 70 % for all the years. In order to give more strength to the findings, the time series analysis of NDVI and NDBI were computed to visualize the distribution of vegetation cover and urban sprawl. The NDVI graphs unveiled declining vegetation, whereas NDBI showed rising urbanization trends. Thus, an urban push is experienced over the study area with profound stress over the natural vegetation. Concurrently, the LST_{max} and LST_{min} increased by 2.92°C and 4.98°C respectively, with the highest temperature reaching 45.88°C in 2020. Statistically, a negative relationship was observed between LST and NDVI, whereas positive relationship was identified between LST and NDBI. This implies that LST increases with the increase in built-up area and bare land whereas it decreases with the increase in forest, cropland, wetland and water bodies. This can build up heat stress in urban areas, leading to the outbreak of various diseases among human beings and pest infestation in the crops. Even though, LST showed an overall increase over the study period, increase in night temperature was more evident compared to the day temperature. This may have consequential impact in the yield of field crops like reduction in tiller/panicle number, decrease in grain weight and grain number per plant etc. Since the major crop is rice over the East and South Eastern Coastal Plain Zone of Odisha, improving the rice crop tolerance to heat stress in terms of sustaining yield stability under high day temperature, high night temperature, or combined high day and night temperature will bolster future food security. In summary, the expansion of urban areas has led to increased temperatures and the formation of Urban Heat Islands (UHI), impacting various climatic variables. Therefore, these findings focus the urgent need for sustainable urban development practices to mitigate the adverse effects of urbanization on the local climate.

Keywords: LULC, NDVI, NDBI, LST, UHI

Conservation and Sustainable Utilization of Horticultural Genetic Resources (HGRs) for Food and Nutritional Security

P. E. Rajasekharan
Email: rajaseharan.pe@gmail.com
Affiliation: Principal Scientist (Formerly) ICAR-IIHR, Bengaluru 560089

Abstract

This paper delves into the pivotal role played by Horticultural Genetic Resources (HGRs) in ensuring global food and nutritional security. Horticultural crops, comprising fruits, vegetables, and ornamental plants, significantly contribute to human diets by supplying essential vitamins, minerals, and dietary diversity. Preserving the genetic diversity within horticultural species is imperative for mitigating environmental challenges, pests, and diseases that pose threats to agricultural productivity. The conservation strategies employing both ex situ (e.g., gene banks) and in situ (e.g., on-farm) approaches, incorporating advanced technologies such as cryopreservation and geospatial tools for efficient management. Utilizing these genetic resources involves the application of advanced breeding techniques, biotechnology, and sustainable agricultural practices to enhance crop yields, nutritional quality, and adaptability to changing climatic conditions. The paper also addresses challenges and opportunities associated with HGR conservation and sustainable use, stressing the necessity for collaborative efforts among researchers, policymakers, and communities to address global food security issues. The focus shifts to harnessing the potential of HGRs for food security, emphasizing breeding programs that leverage genetic diversity to develop nutrient-rich, high-yielding, and climate-resistant varieties. The ethical and sustainable utilization of HGRs, while safeguarding traditional knowledge and farmer participation, is underscored. Understanding and harnessing genetic diversity within horticultural crops can lead to resilient and nutritious food systems, contributing to the well-being of present and future generations. The article concludes by addressing challenges and opportunities in optimizing HGR conservation and utilization, highlighting the crucial need for effective partnerships between researchers, policymakers, and farmers. It emphasizes investment in capacity building and knowledge sharing as essential for empowering local communities to manage and benefit from HGRs.

Keywords: HGRs, Conservation, Ex situ, In situ, Sustainable utilization

Tracking NO_2 emissions in Cauvery Delta Zone: A Machine Learning approach on Google Earth Engine

Ajay Prakash*, Fawaz Parapurath

Tamil Nadu Agricultural University, Coimbatore - 641003, Tamil Nadu, India

***Corresponding author - aj23723@gmail.com

Abstract

Nitrogen oxides (NOx), including nitrogen dioxide (NO_2) and nitric oxide (NO), are trace gases found in both the Earth's troposphere and stratosphere. They are considered as one among the major air pollutants causing harmful effect to human health and environment. The use of nitrogen fertilizers in agriculture produces significant quantities of nitrogenous gases including ammonia, nitric oxide, and nitrous oxide, which contribute to the formation of smog and acid rain. Although, AQ (Air Quality) monitoring networks can be geographically sparse, especially outside of major urban areas, satellite-based Nitrogen dioxide (NO_2) observations with global coverage have now become available for monitoring air pollution levels at city scale. In this study, the monthly emission of NO_2 (Total vertical column of NO_2 mass concentrations - tonnes) was estimated for Cauvery delta zone (includes the districts, namely Thanjavur, Thiruvarur and Nagapattinam) over 2022 based on ML (Machine Learning) approach using java scripting in GEE (Google Earth Engine) platform. GEE is an open access cloud-based computing platform which provides the code snippet for various datasets globally. The dataset employed for the current study is Tropospheric Monitoring Instrument (TROPOMI) on the Copernicus Sentinel-5 Precursor (S5P), which provides high-resolution satellite based NO_2 vertical column densities (VCDs), built upon prior NO_2 retrieval algorithms. The results revealed that, among the months, the highest and lowest NO_2 emissions were recorded in the month of October and January respectively. In the month of October, the emission was around 24.46 tonnes (11.1 % above from the normal) and in January it was 19.64 tonnes (10.8 % below from the normal). Therefore, this methodology can be used to track the spatio-temporal variations in the emission of GHGs (Greenhouse gases) mainly carbon dioxide, methane, sulphur oxides (SOx) etc., and better farmland management practices can be adopted for clean water environment by reducing the emissions.

Keywords: Machine learning, Google earth engine, Air quality, Nitrogen dioxide, Greenhouse gases

Spatiotemporal analysis of Rainfall patterns in the Sundarbans region of India and Bangladesh (2000-2019) using era5 Atmospheric Reanalysis data

Piyali Sarkar*, Manoj Kumar Nanda, Argha Ghosh, Debolina Sarkar
Department of Agricultural Meteorology and Physics
Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, Pin-741252
**Corresponding Author Email: piyalisarkar989@gmail.com*

Abstract

The Sundarbans, world's largest mangrove forest delta, stretches across the international borders of India and Bangladesh, serving as a biodiversity hotspot and a vital source of livelihood for millions.

However, it faces recurring challenges arising from anthropogenic activities and climate-induced disruptions, including timber exploitation, pollution, sea-level rise, coastal erosion, heightened salinity, an increased frequency of cyclones, and intensified storm surges. This study conducts a thorough analysis of rainfall patterns in the Sundarbans from the period of 2000 to 2019. Utilizing the ERA5 reanalysis dataset, our study carefully examines rainfall records, revealing distinct patterns and notable trends in this region. To understand the intricate pattern of spatial rainfall variability, the entire Sundarbans Forest area has been methodically divided into sixteen 30 km x 30 km blocks, delineating geographical orientation from south to north and west to east through a unique combination of row (R) and column (C) numbers. The acquisition of ERA5 monthly rainfall aggregate data is facilitated through the Google Earth Engine (GEE) platform, enhancing our capacity for rainfall trend analysis. Annual and seasonal (pre-monsoon, monsoon, and post-monsoon) rainfall metrics for each block were calculated which enabled detailed assessment of spatiotemporal variation. Our findings showed that over the study period, an average annual rainfall of 1840 mm is recorded, with a dominant 63.15% (1162 mm) occurring during the monsoon season. Interestingly, the temporal variability of monsoon rainfall is quite low (7.4%) whereas a more noticeable difference was observed in spatial variability (14.9%). Yearly fluctuations in annual rainfall register at 5.6%, while spatial variability exhibits a wider range at 15.3%. Notably, pre-monsoon rainfall exhibits an east-west and north-south gradient within the study area. During the monsoon season, pronounced spatial variability is observed, with northern and eastern blocks receiving lower rainfall (1000-1200 mm) compared to southern blocks, which record relatively higher rainfall (1150-1400 mm). Post-monsoon rainfall exhibits a distinct spatial pattern with less temporal variability. This study serves as a reference, for protecting the ecology and adapting to climate challenges in this significant area.

Keywords: Sundarbans, ERA5 Atmospheric Reanalysis data product, spatiotemporal rainfall pattern, GEE213

Theme 2: Case studies and Success stories

Key note address For Theme 2

Exploring the Imperative of Considering Cross-Cutting Determinants in Food Environments for Achieving Food and Nutrition Security: Insights from Case Studies

Subba Rao M Gavaravarapu
Scientist F & Head
Nutrition Information, Communication and Health Education Division
ICMR- National Institute of Nutrition, Hyderabad

In light of the complex nutritional challenges prevalent in India, encompassing undernutrition, micronutrient deficiencies, and escalating rates of overweight, obesity, and non-communicable diseases across diverse economic and geographical contexts, the quest for effective and sustainable solutions continues. Despite the implementation of short-term and medium-term measures, progress, particularly under the POSHAN Abhiyaan initiative, has been sluggish. The shift from mere food security to comprehensive nutrition security hinges on a long-term and sustainable strategy. Ensuring diversified diets is crucial for optimal health, providing essential nutrients, and addressing nutritional well-being challenges in India, where a lack of diet diversity remains a significant concern.

To tackle this issue, collaboration between the agriculture and nutrition sectors is pivotal, not only to promote food security but also to ensure nutrition security through diet diversity. Encouraging the cultivation of a diverse range of crops and implementing nutrient-sensitive agricultural practices can enhance the nutritional content of crops. Education and awareness programs play a vital role in emphasizing the importance of diet diversity and providing information on locally available nutritious foods. However, rather than solely targeting individuals for behaviour change, a food systems approach is necessary, engaging various sectors and stakeholders.

Research and innovation in agricultural practices and food processing technologies can contribute to the development of nutrient-rich crops and innovative methods to preserve and deliver diverse nutrients. Community engagement, involving local communities in agricultural and nutritional initiatives, fosters a sense of ownership and encourages the adoption of diverse diets. Supply chain integration between agriculture and nutrition sectors is essential for efficient delivery of diverse and nutrient-rich foods to consumers.

To sustain and expand this cross-cutting dialogue among stakeholders, a continuing discussion is crucial, and this brainstorming session aims to facilitate that. The dietary guidelines for Indians, as outlined in 'My plate for the day,' advocate the consumption of all food groups. However, data from the National Nutrition Monitoring Bureau (NNMB) reveals that diets in 16 Indian states, both in rural and urban areas, are monotonous and nutritionally inadequate across age groups and genders. The inadequate consumption of diversified food, coupled with excessive intake of high-fat, salt, and sugar foods, as well as physical inactivity, is linked to various non-communicable diseases (NCDs). Additionally, micronutrient inadequacy due to low dietary diversity is associated with stunting, wasting, and underweight among children under 5 years old.

The National Family Health Survey (NFHS V) highlights that only 11% of children aged 6-23 months achieved the minimum dietary diversity (MDD) recommended by the World Health Organization (WHO).

There is a considerable disparity between dietary recommendations and actual consumption practices in both rural and urban communities, with limited studies on perceptions and awareness regarding diet diversity and its importance in the broader food system.

Various factors influence an individual's ability to maintain a diversified diet, including socio-economic status, knowledge, attitudes, practices, literacy, family size, and food systems. The transition in food choices and behaviour is intricately connected to evolving food environments. The subsequent discussion will delve into these multifaceted factors affecting the consumption of diversified diets by individuals.

Case Study 1:
We developed a methodology to contextually assess the food environment using a 5A's Approach i.e. availability, accessibility, affordability, accommodation and acceptability to diverse foods. In order to bring the recommendation of dietary diversity in practice, it was essential to understand whether a variety of foods are available in the market? If available are they accessible? If accessible, are they affordable? If affordable, are they acceptable and accommodative in the daily menu of the participants? All these research questions were studied not only through the quantitative methods (actual), but also from the qualitative methods (perception) through focus group discussions with caregivers and in-depth interviews with food vendors. The quality of the 5 A's was graded on the basis of concurrence between actual and perceived measures. The results indicated that objective measures could fail to measure the intricacies that are lying in the perceptions of the individuals within the environment and thereby could have an impact on not only diversity but also food and nutrition security. Agriculture, horticulture, and customer interface is an important prerequisite for a sustainable food-based approach to combat food insecurity malnutrition. Though agriculture was not studied, the components identified in this study point towards the need to strengthen the linkages between agriculture productions, supply and to address the demand issues as well as willingness to accommodate diverse foods in the daily diets of the study population.

Case Study 2: The Nutri-Garden Project, an initiative led by the M.S. Swaminathan Research Foundation (MSSRF) sets out to address the issue of malnutrition in rural areas of India by establishing nutrition gardens (kitchen gardens) in approximately two thousand households across four regions in the country. This pilot project aimed to bridge the gap between agriculture and nutrition by promoting the cultivation of bio-fortified plant species specific to agro-ecological zones. To gain insights into the project's effectiveness and impact on the food and nutrition security vis-à-vis diet diversity, a comprehensive assessment study was carried out at the four designated project sites.

The study aimed to evaluate the progress and outcomes of the Nutri-Garden project implementation in terms of the perceptions and practices of beneficiaries regarding the MSSRF's Nutri-Garden project vis-à-vis their perceived food security scenario. A community-based case-control study employing mixed method approach was conducted. It is very important to note that although the food insecurity was reported to be slightly higher in the experimental groups in all the states, the dietary diversity score was better in experimental groups in majority of the states. This could be attributed partially to the seed and sapling distribution under Nutri-Garden initiative along with the nutrition education imparted to the participants of the MSSRF and KVKs. This clearly indicates that the program has immense potential to raise the diet diversity and it could also translate to food/nutrition security when sustained for a long time and integrated with other nutrition programs.

Organic Vegetables and Fruits Production at Home: A Sustainable Approach to Healthy Living

Anushi[1], Dr. Sanjeev Kumar[2], Abhishek Singh[3]

1. Research Scholar at Department of fruit science, College of Horticulture,
Chandra Shekhar Azad University of Agriculture and Technology, Uttar Pradesh (208002)
2. Professor in the Department of Agronomy,
C.S. Azad University of Agriculture and Technology, Kanpur
3. Ph.D. Scholar at Department of Agricultural Economics,
Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh

Abstract

The increasing awareness of health and environmental concerns has led many individuals to seek alternative methods for obtaining fresh, nutritious produce. This abstract explores the concept of producing organic vegetables and fruits at home, emphasizing a sustainable and environmentally friendly approach to agriculture. Home gardening has gained popularity as a viable solution to ensure a regular supply of organic produce, free from synthetic pesticides and fertilizers. This study delves into the various methods and techniques that can be employed for successful organic gardening, considering factors such as soil health, composting, and natural pest control. I am harnessing benefits of organic production for the past 10 years. Cultivating the crops year's rounds from bedding preparation to ultimate harvesting creates the environment of health and peace for my whole family. We sow the beds for 2 seasons with tremendous of fruits and vegetables. It includes potato, radish, carrot, Cole crops, leafy vegetables such as spinach, coriander, fenugreek, tomatoes, brinjal, crucifers, cucumber, pumpkin etc. in vegetables to strawberry, mangoes, guava, banana, cape gooseberries in fruits. I also produce turmeric and red pepper in spices. This year around cultivation can fulfil the demand of 70 percent of our needs. Moreover, it explores the role of technology in facilitating home organic farming, discussing innovative tools and applications that can assist individuals in managing their gardens effectively. The findings of this research suggest that cultivating organic vegetables and fruits at home not only contributes to individual well-being but also promotes sustainable agriculture on a smaller scale.

Keywords: Home, Vegetables, Fruits, Composting

Revolutionizing Agriculture: Unleashing the Power of Artificial Intelligence for Smart Farming

Ch. Saikiran[1*], K. Pavan Kumar[2], Shaik Muneer[1]

Ph.D. Scholar[1], Indira Gandi Krishi Vishwavidyalaya, Raipur (C.G.), Ph.D. Scholar[2], PJTSAU, Hyderabad (T.S) ***Mail ID:** Saikiran.52csk@gmail.com*

Abstract

Artificial Intelligence (AI), a pivotal realm in computer science, has permeated diverse sectors like education, healthcare, finance, and manufacturing due to its inherent ability to address complex problems beyond human capacity. Agriculture has swiftly embraced AI, leveraging cognitive computing to simulate human thought processes in computers. This turbulence in AI-powered agriculture enhances efficiency by interpreting, acquiring, and reacting to diverse situations. Microsoft Corporation's collaboration with 175 farmers in Andhra Pradesh, India, exemplifies the transformative impact of AI in agriculture.

The partnership provides services and solutions for land preparation, sowing, and nutrient management. Various cognitive solutions address challenges in agriculture, including automated farming activities, early identification of pest and disease outbreaks, crop quality management, and monitoring biotic and abiotic factors through machine vision systems and phenotype adjustments. Despite AI's promising applications, agriculture faces significant challenges such as irrigation issues, temperature fluctuations, groundwater density, food scarcity, and wastage. Yield management using AI, coupled with futuristic technologies like cloud machine learning, satellite imaging, and advanced analytics, and creates a smart and sustainable farming ecosystem. Microsoft's pilot project in Andhra Pradesh utilizes AI-based applications, transforming data into intelligent actions through the Cortana Intelligence Suite. This includes an AI-based sowing application recommending optimal sowing dates, land preparation, and nutrient management, resulting in a notable 30% increase in average crop yield per hectare. AI models further contribute to recognizing optimal sowing periods based on climatic data, real-time Moisture Adequacy Data (MAI), and soil moisture, aiding farmers in decision-making.

Key words: Intelligence, Farming, Interpreting, Challenges, Technologies.

Unraveling the Business Model of Millet Enterprise for Achieving Food and Nutritional Security: A Case Study

Rakesh Bhatthad[*1], Vikas Chowhan[2], Parashuram Kambale[3] and Pradeep Kumar T L[4]

[1]Ph.D. Scholar, Department of Agricultural Extension Education, College of Agriculture, UAS, Raichur-584 104, Karnataka, INDIA.

[2]Ph.D. Scholar, Department of Agricultural Extension Education, College of Agriculture, UAS, Raichur-584 104, Karnataka, INDIA.

[3]Ph.D. Scholar, Department of Agricultural Extension Education, College of Agriculture, UAS, Raichur-584 104, Karnataka, INDIA.

[4]Ph.D. Scholar, Department of Agricultural Extension Education, College of Agriculture, UAS, Raichur-584 104, Karnataka, INDIA.

[*]Corresponding author Email ID: rakeshbhattad20@gmail.com

Abstract

There is a growing consensus that one of the key priorities to address food and nutrition security is to aim at the transformation of agriculture and food systems. Millet, a group of small-seeded grasses, has gained attention for its nutritional richness and resilience in diverse agro-ecological settings and entrepreneurs interested in harnessing the potential of millets to achieve broader goals of food and nutritional security can play an important role in this. It is often argued that the success at low-income markets requires innovative and inclusive business models. However, research findings on this have been quite descriptive and generic. The literature has strong focus on the participation of businesses in the value chain and the food system and this article aims to contribute to an improved understanding with regard to inclusive business model characteristics of millet enterprise interventions aiming at food and nutrition security improvements, by scrutinizing a case from Raichur district of Karnataka. The study focuses on the internal fitness by analyzing the foundation level components of the inclusive strategic business model. Important findings are the relevance of quality of product or service besides its affordability, marketing and distribution strategies to link the different actors in the value chain, and increase the success of the inclusive business model for improved nutrition and food security ultimately contributing to the existing body of knowledge by offering practical insights into the development and scaling of successful millet-based business models and thereby fostering a more resilient and nutritionally secure global food system.

Keywords: Food system, Internal fitness, Nutrition security, Business model, Value chain.

Mechanization for Precision and Easy Rice Farming Systems: A Success Story from Andhra Pradesh, India by Praanadhaara

Pundarikakshudu

Abstract

Rice is a staple crop in India, but its cultivation is labour intensive and drudgery based. It requires around 850-900 man hours per hectare, mostly for transplanting, weeding, and harvesting. These operations account for 65% of the total cultivation costs, while labour availability and pricing are becoming major challenges for farmers. Moreover, the level of mechanization in rice farming systems is very low in India, due to the lack of suitable technologies and institutional support.

Praanadhaara Group, has been conducting extensive research for the last 7-8 years, to find innovative solutions for reducing labour use and increasing mechanization in rice farming. Their aim is to bring down the labour cost of the total cultivation cost, while enhancing the productivity and profitability of rice farming.

One of their key innovations is the direct sowing of rice (DSR), which eliminates the need for transplanting pre-grown seedlings. DSR can be done in two ways: dry direct seeding of rice (D-DSR) and wet direct seeding of rice (W-DSR). D-DSR involves sowing pre-germinated seeds in dry soil, while W-DSR involves sowing seeds in wet soil after puddling and levelling. Praanadhaara has modified equipment and the tractors to suit the conditions of DSR.

Another innovation is the inter-cultivation operations, such as weeding, fertilizing, and pesticide application, using tractor drawn equipment designed by Praanadhaara. These operations reduce the labour use and drudgery, and increase the efficiency and productivity.

Praanadhaara has demonstrated the benefits of DSR and inter-cultivation operations to the farmers of Jammulapalem village, Bapatla district, Andhra Pradesh. The farmers have reported increased yields, reduced costs, and higher revenues from cultivating rice. Praanadhaara has proved that "Easy Rice Farming" by using modified mechanization is possible in India, with sustainable results.

Key words: Pranadhaara, Inter-cultivation, Precision, Mechanisation, Rice farming systems

Success stories: Organic farming and Millets Processing

K. U. Deshmukh
Assistant Professor, Agricultural Extension and communication, Shriram College of Agriculture, Paniv affiliated to Mahatma Phule Krushi Vidyapeeth, Rahuri, Maharashtra.
Corresponding Authors email: kavita25deshmukh@gmail.com Contact no. 7709343238

Abstract

This paper contains success stories of young entrepreneurs doing organic farming and millet processing from Maharashtra state. Mr. Sachin Tanaji Yevle from Sangli district completed education then worked for 5 years in Company. But he was not satisfied with his job. So he leave job and doing organic farming. He did an innovative experiment of growing 30 organic crops in 30R, and this was successful. He started selling organic vegetables, fruits and pulses and is still continuing today. Now he has registered 'Krishidoot Brand', delivering various organic products to customers in Pune, Mumbai cities. He always working to spread awareness of organic farming in society and honored by district, state and national awards. Second success story of Mrs. Rupali Vikas Pawar from Solapur district. Along with her family she was totally dependent on agriculture. But while doing agriculture there were so many problems, started small business by purchasing an old flour mill to supply sorghum, millet, maize, khapli wheat flour etc., to the city. At the same time, they started making homemade cookies, as the demand increased and to reduce the gap in the demand, she decided to take a large quantity of production. An application was submitted for project cost Rs.12.53 lakh to the Pradhan Mantri Food Processing Industry. Out of the total project cost the bank approved a loan of Rs. 9 lakh and now annual net profit from this business is 10 to 12 lakh.

Key words: Success story, Organic farming, Millet processing, Entrepreneurs etc.

Plantation crops for food and nutritional security with multiple health effect

Gawas, I. G*., Gajbhiye, R. C., Kakade, A. R., Dongare, S. V.

[1,2] Deapartment of Plantation, Soices, Medicinal and Aromatic crops

[3]Department of fruit science

[4] Department of Livestock production management

[1,2,3] College of Horticulture Dapoli, Dr. B. S. K. K. V. Dapoli

G. B. Pant University of Agriculture and Science, Pantnagar, Uttrakhand

Abstract

From the beginning of human history, food has been considered as major factor in maintaining health. Active ingredients from food are effective in promoting human health which is present in different food groups such as pulses, legumes, fruits, vegetables, spices and plantation crops. (Kulshrestha, 2018) Among all these group plantation crops like coconut, Arecanut, Cashew, Betelvine, beverge crops plays a significant role in human nutrition, especially as a source of vitamins, minerals and proteins, essential oils with their different nutraceutical properties.

In present era lifestyles of human have changed drastically due to the globalization, living speed, longer work schedules, junk food habits as well as imbalanced nutritional food and various psychological pressures, which led to increase in many health issues. (Anon, 2021)

Nutraceutically, rich plantation crops are rich source of various nutraceutical properties. (Sarma *et al*., 2018) found meetha variety of betel vine is rich source of carbohydrate, proteins, and phenols as compared to banarasi variety. (Daramola *et al*., 2014) reported that Halogen oven roasted cashew having more nutrients than plain and conventional oven roasted cashews.

With the advancement in the technology of plantation crops and on knowledge of pharmacology of their active principles, their health benefit effects were investigated more thoroughly in recent decades. (Gullapalli, 2013) concluded tender coconut water is effective on lowering blood pressure. (Soudah *et al*., 2021) reported virgin coconut oil beneficial as moisturizer and (David and Novotny, 2019) reported cashew consumption is having no much effect on body lipoprotein level.

(Widhiarta, 2016) found supplementation of Virgin coconut oil to the HIV +ve people can increase their immunity to fight against virus. Plantation crops hold great potential to handle health issues & have scientifically proven health benefits and their consumption & use will keep diseases at away and maintain an overall good health.

Keywords: Nutrition, Health, Nutraceuticals, Plantation, Coconut.

A Success story: Three storied farming in Agro-forestry in West Bengal

Bimal Lama
Affiliation: Forest Research and Training Centre

Abstract

Bhumi Jung, KC. The 84-year-old man from Putalibazar-11, Karindanda, Syangja, Nepal, is an agroforestry practitioner. He owns a farm named "Falful bagaicha tatha highland coffee nursery farm (Fruits orchard and highland coffee nursery farm)," which covers 5.5 hectares. There is a short story about how he started an organic agroforestry farm. Once, he asked an agricultural technician to suggest farming, which is suitable for lazy people. The technician told me that pineapple, banana, and guava farming require less labor and are beneficial. He borrowed 2500 seedlings of pineapple, 200 seedlings of banana, and 300 seedlings of guava. He also started farming oranges and coffee. This is how he started agroforestry in 2033 B.S. He had made a commitment not to have his daily meal without planting 10 plants a day. Laborious years passed despite various challenges, and as a result, he is now the owner of a highly productive organic farm, from which he earns about $22,000–24,000 as an annual income and also provides employment for others. At present, his farm is rich in many species of trees, fruits, crops, and vegetables.

Key words: Organic, Farming, Agroforestry, Coffee, Income

Small is Meaningful: Case studies of frugal agriculture innovations from Nagpur district, Maharashtra

Dr. Mittali Sethi[3]*, Maitreyee Pathak[4], Ankita Rathor[5], Sima Mundle[6], Dr. Sachin Mandavgane[7]

Corresponding author. Institutional affiliation (IA) - Director, Vasantrao Naik Agricultural Extension Management and Training Institute (VANAMATI). Address - VANAMATI, Nagpur. Email ID - sameti123@yahoo.co.in.

Abstract

This research study discusses the importance of frugal innovation in agriculture practices. Frugal innovation, often termed as "*Jugaad*" in India, is about innovating cost-effectively and sustainably, particularly in resource-constrained environments. Frugal innovation is crucial in regions with economic constraints, providing cost-effective and efficient solutions and promoting sustainable development through environmentally conscious practices. It empowers communities by supplying accessible tools and technologies, addressing needs frequently neglected by traditional markets, especially in marginalized areas. The paper discusses these aspects of *Jugaad* through three case studies which were documented by the authors through field study. The first case study highlights the circular economy built around a dairy farm and use of animal waste to produce vermicompost with generation of an additional income source. For the second case study, the authors demonstrate different aspects of localised production of Tricho-card by Self-help group (SHG) women which is an effective biocontrol pest measure. Such decentralised production helps the farmers to get the product on time and saves the cost involved in getting this from the marketplace. The third case study brings out how the Jugaad in automation of drip irrigation helps in judicious and timely use of resources like water supply and fertilizers and reallocates the human capital towards its most productive use. These case studies also align to India's commitment to Sustainable Development Goals (SDGs). This research study has direct relevance for practical implementation of field initiatives and policy formulation as it underlines the challenges faced by rural innovators, the processes involved in the application of frugal innovations on field and the policies that have or can increase replicability and scalability.

Keywords: Frugal innovation, Circular economy, Sustainable agriculture, Decentralization, Entrepreneurship

Mapping of Maize Value Chain in Context of Farmer's collectives– A Case of Swakrushi Farmer Producer Company Limited, Warangal

V. Usha Sree & Jyoti Sahare
Consultant-MANAGE-Hyderabad
Contact email: ushasree303@gmail.com, jyotidhanraj@gmail.com

Abstract

Maize is the major staple crop in Warangal district of Telangana state, but its potential to generate income for farmers is limited by challenges associated with production and marketing. Recently, farmers producers companies playing significant role to get profit through collective participation. The Swakrushi Farmer Producer Company Limited, Warangal, is established at Warangal district and working on collective perspective to generate more profit for Maize farmers. This study aims an attempting to make an in-depth analysis of mapping maize value chain of Swakrushi Farmer Producer Company Limited, Warangal District, Telangana. The sample includes the actors of value chain verticals viz., (1) Maize farmers (30 member farmers, 30 non-member farmers), commission agents (2), processors (1) retailers (2) and 30 consumers were selected and survey conducted using Interview schedules and questionnaires. The core processes and actors involved in maize value chain are mapped and analyzed. The main constraints faced by Swakrushi member farmers were lack of market place, marketing knowledge, and lack of technical and advisory services from the agricultural experts. Through Swakrushi Farmer Producer Company limited, member farmers are benefitting additional Rs. 0.81 for every 1 rupee invested, apart from gaining benefits of subsidy for the agri-inputs and slightly increased procurement price.

Key Words: Value chain analysis, mapping, stakeholders and marketing channel, Farmers Producer Organization

Farmer Collectives – Paving the way for Sustainable Food Systems

Vignesh Kumar.S[1], K.C. Gummagolmath[2] and Punith Kumar[3]
[1] MANAGE Fellow, [2] Director (M & E), [3] Programme Executive,
National Institute of Agricultural Extension Management (MANAGE), Hyderabad

Abstract

The present investigation was conducted by leveraging published sources and secondary information. A total of five case studies of successful Farmer Producer Companies were critically analyzed to ascertain how the collectives can support sustainable food systems. The findings uncovered distinctive focal point and operational strategies, contributing not only to their prosperity but also ensuring sustainability. For instance, Aadhimalai Pazhangudiyinar Producer Company and DevBhumi Natural Products Producer Company, dedicated to the economic empowerment of indigenous communities, have concurrently engaged in the preservation of natural resources. They achieved this through the adoption of sustainable farming practices and the implementation of organic cultivation methods among their members, with a vision for conservation through enterprise. Considering another instance, Susag Farmer Producer Company exclusively focusses on Millet cultivation involving active participation of women. The current acclaim of millets as the standard-bearers of sustainable food systems further substantiates this focused approach. This aligns with the long-term goal of attaining nutritional security. This commitment is exemplified to the extent that the producers proudly identify themselves as the Millet Sisters Brigade. Bhumitra and Aranyak, two distinct producer companies, centre their efforts on elevating farmers from profoundly disadvantaged agricultural regions. Their approach involves establishing a robust value chain and rationalizing pricing mechanisms. Gradually, these companies inspire farmers to embrace sustainable farming practices, envisioning a more promising and resilient future for agricultural communities. In essence, the present study illuminates the potential trajectory of farmer collectives emerging as a pivotal force in the Indian farming landscape, propelling us toward the realization of sustainable food systems—a journey that lies ahead.

Keywords

Farmer Producer Companies, Sustainability, Collectives, Food Systems

Theme 3: Climate Resilient Agriculture

Key Note Speaker for Theme 3

Dr. Swati Nayak
South Asia Lead, Seed Systems and
Product Management,
International Rice Research Institute
Borlaug Field Award Recipient, 2023

Cultivating Resilience: Nourishing the Future through Agriculture holistic approaches

The critical need for climate-resilient agriculture has grown more apparent as the impact of climate change continues to threaten global food security. There is a need for transition to sustainability, and we need it fast. Without it, direct and indirect shocks will worsen over time, and will affect the planet, citizens, and market. As, the food demand is predicted to grow by at least 50 percent, we urgently need to scale up investments in climate — resilient agriculture to ensure future generation is well placed to have access to surplus. Climate adaptation and mitigation strategies, increased emphasis on development for resilient varieties, crops and resilient seed systems, management practices and sustainable food systems are the need of hour. While we create avenues to let these strategies and practices get mainstreamed, the critical role of the smallholders, entire farming community including women in agriculture should not be ignored. Their co-ownership in this process would be critical for a comprehensive result, adoption, scalability, and impact envisaged.

Development, scaling, and adoption of resilient cultivars and seeds would remain critical while scaling climate-resilient agriculture and associated technological solutions. Considering, changing climatic circumstances, it is critical to engage in breeding programs that create crops that can tolerate extreme weather events, pests, and diseases. There is a need to focus on the most recent advances such as the creation of drought-tolerant, heat- resistant, and disease-resistant cultivars. This not only provides higher harvests, but also helps agriculture adapt to the changing environment. The development of several new multi-stress resistant varieties needs to be in the priority list by researchers to meet the demands of the ever-growing population worldwide.

Agriculture could play crucial role in carbon sequestration through tree plantation on farmland as approximately 13 percent of total greenhouse gas emission (GHG) in the country is contributed through agricultural practices. There is need for direction in economic analysis of agriculture

production, considering the impact on natural resources, climate change, and future generations.

Incorporation of metrics beyond financial price to evaluate the economic impact of agricultural activities, devising appropriate methodology around carbon credit programs to encourage, and incentivize stakeholders are also some futuristic goal we must work towards.

Technologies like direct seeded rice (DSR) hold great potential to let our farming systems shift from current labor, water, and energy intensive practices carried through transplanting methods. DSR being known as economically viable and environmentally promising technology can be scaled with integrations of tailored agronomy and also cultivars developed for the same. Investing in enabling environment for mechanized DSR, capacity development, awareness, appropriate incentive systems, and also investing in development of DSR-fit varietal development which can exhibit traits for better germination, growth, survival, and vigor under direct seeding conditions can be a critical way forward.

Innovative solutions are critical for boosting climate-resilient agriculture, especially with rapid technological advancements. Insights of cutting-edge technology including precision agriculture, data-driven decision-making, and the use of drones to monitor and manage agricultural landscapes can be combined for farmers to make more informed decisions, optimize resource usage, and offset the detrimental effects of climate change on agricultural output. That is why we need to reward farmers who integrate nature into their business models. We need to stimulate demand for these products.

While we invest and engage with innovation around technological developments, the role of extension and innovation in scaling would eventually be the most critical way forward for the change intended. The pathways for scaling and adoption of climate-resilient agriculture would require comprehensive strategy for demand and awareness creation, market inclusive positioning, and socially inclusive models of delivery. The significance of a multi- stakeholder approach will come to play in addressing climate change in our country, including the most crucial public-private and community partnerships. There is importance and need of considering the perspectives of small and marginal farmers who contribute to 85 percent of the farming population in India. Furthermore, women and women-led institutions could play a pivotal and significant role here as they remain to be the most vulnerable segment affected by climate change. Ensuring active engagement of women in decision making, delivery, and scaling processes not only strengthens agricultural systems, but also promotes gender equality and social inclusion, the much needed impact goals.

As a significant actor in extension management, key institutions like MANAGE can plays a central pillar in positioning, scaling of climate-resilient agricultural practices, and most importantly creating an enabling eco-system for policy, program, strategies, and partnerships in this direction.

The conference is timed very well in the critical phase we are and aptly structured to delve deep into the problems and potential of bringing innovative solutions, and strategies in the climate

resilience space, engaging with a wider audience. By emphasizing the need of collaboration among research institutions, government agencies, private sector and civil society, community organizations, together we can play a greater role in disseminating information and best practices, eventually leading to better understanding, willingness, and scaled adoption of climate-resilient agricultural practices

Weather-indices based Crop yield prediction using Statistical and Machine learning models

Ajith S[1] and M.K. Debnath[2]

[1]International Maize and Wheat Improvement Centre (CIMMYT-India), Hyderabad, India.

[2]Assistant Professor, Department of Agricultural Statistics, UBKV, West Bengal.

[1]ajithagristat@gmail.com

Abstract

The extent of weather effect on crop yield is not only depends on magnitude of weather factors; but also, the distribution pattern of each weather factor over the crop season. For example, Potato crop tuber induction is best at 15°C, tuber initiation is at 22°C and tuber setting is at 15°C. Hence it is appropriate to assign weight to weekly weather conditions while fitting prediction models for more precise estimates of potato yield. In order to give weightage to the respective week's weather conditions, correlation coefficient as well as path coefficient based weighted weather indices are used in this study. Stepwise Regression (SR), Principal Component Analysis (PCA) and Partial Least Square Regression (PLSR) are employed to select input variables for model fitting in a view of avoiding overfitting issue, increasing speed of training algorithm and to avoid multicollinearity issue. Multiple Linear Regression (MLR) and two machine learning models namely, Artificial Neural Network (ANN) and Support Vector Regression (SVR) are fitted using the input variables selected from SR, PCA and PLSR. The study area for the present investigation is four northern districts of West Bengal namely, Cooch Behar, Jalpaiguri, Malda and Uttar Dinajpur. The results revealed that PLSR-ANN, PLSR-SVR, PCA-SVR and PLSR-SVR models are found to perform better for predicting potato yield in Cooch Behar, Jalpaiguri, Malda and Uttar Dinajpur respectively. It can be observed that the models using PCA as well PLSR scores as input are performed better than the models based on SR. Hence it can be concluded that the non-linear machine learning models coupled with variable reduction methodologies found to perform well for region specific crop yield prediction.

Keywords: Potato, Weather-Indices, Statistical models, Machine Learning models, Prediction.

Agro-forestry: A Potential and Sustainable Approach to Climate-Resilient Agriculture

Abhishek Pratap Singh
Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, U.P., India.

Abstract

Communities are already facing high levels of poverty and vulnerability and their ability to survive is also under the threat due to pressure of climate change. Farmers must adjust to variations in temperature, precipitation, and weather patterns as well as the cascading repercussions of these changes. However, they must also take care to prevent exacerbate climate change on their farms. Agroforestry, an integrated land-use management system that combines trees and shrubs with crops and/or livestock, has emerged as a promising approach to address the challenges posed by climate change in agriculture. This paper provides a comprehensive review of the role of agroforestry in enhancing climate resilience within agricultural systems. The paper highlights the multifaceted benefits of agroforestry in promoting climate resilience.

These benefits include increased crop and livestock productivity, improved soil health, enhanced water-use efficiency, and diversified income sources for farmers. Furthermore, the review addresses the adaptive capacity of agroforestry systems to changing climatic conditions, such as extreme weather events and shifting precipitation patterns. The inherent ability of diverse agro ecosystems to buffer against climate-induced shocks is discussed, along with the potential of agroforestry to contribute to broader landscape-level climate adaptation strategies. Challenges and constraints associated with the adoption of agroforestry practices are examined, including institutional barriers, knowledge gaps, and conflicting land-use policies. Strategies to overcome these challenges and promote widespread adoption of agroforestry for climate resilience are proposed, taking into account the socioeconomic and cultural contexts of diverse farming communities.

Keywords: Climate Change, Sustainable Agriculture, Carbon Sequestration, Climate Resilience, Food Security and Livelihood.

Assessing Climate Change Vulnerability in Maharashtra's Konkan Rice Belt: A District-Level Analysis

Aishwarya S. Akhare[1], P. J. Kshirsagar[2], S. R. Torane[3] and V. G. More[4]

[1]Ph.D. Scholar, Department of Agricultural Economics, DBSKKV, Dapoli

[2]Associate Professor, Department of Agricultural Economics, DBSKKV, Dapoli

[3]Head, Department of Agricultural Economics, DBSKKV, Dapoli

[4]Agrometeorologist, AICRP on Agrometeorology, Department of Agronomy, DBSKKV, Dapoli

Abstract

A comprehensive assessment was conducted to gauge the influence of climate change on rice production across various districts in Konkan region of Maharashtra. This evaluation utilized historical data and followed the methodology outlined by the Intergovernmental Panel on Climate Change (IPCC) to assess sensitivity, exposure, and adaptive capacity indicators. The outcome of this process was the computation of a composite vulnerability index for 4 rice-producing districts, achieved through the normalization of variables for comparison and the assignment of weights based on sensitivity, exposure, and adaptive capacity through principal component analysis. These districts were then categorized based on their vulnerability levels, distinguishing between high, moderate, and low vulnerability by using mean and standard deviation norms. The analysis brought to light diverse levels of exposure, with Raigad demonstrating the highest exposure (0.55), and Sindhudurg displaying the lowest (0.34). Thane showcased the most sensitivity (0.75), while Ratnagiri exhibited the least (0.05). In terms of adaptive capacity, Thane displayed the highest (0.79), while Raigad scored the lowest (0.20). Raigad was identified as the most vulnerable district (0.88), whereas Ratnagiri emerged as the least vulnerable among the rice-producing districts (0.13), underscoring the imperative needs for tailored adaptation strategies in Konkan region of Maharashtra.

Keywords: Rice, climate change, vulnerability, exposure, sensitivity, adaptive capacity.

From Awareness to Action: Strategies for Enhancing Adoption of Climate Information services

Anuhya P*[1], Venkatesan P, Lakshmi T

*[1]Ph.D Scholar, Agricultural Extension Education, S V Agricultural College, Tirupati, ANGRAU, anuhya1510@gmail.com

Principal Scientist, Extension Systems Management, ICAR-NAARM, Hyderabad

Professor and Head, Agricultural Extension Education, S V agricultural College, Tirupati, ANGRAU

Abstract

Indian Agriculture is highly uncertain due to irregular weather patterns, fragmented land holdings, uncertain government policies. Despite this nearly 70 percent of the population is dependent on agriculture as of 2022-23. Due to its dependence on weather and climate, making available timely and accurate location-specific climate information is essential for effective farm management. Climate Information Services (CIS) encompass a diverse array of tools and systems specifically crafted to gather, analyze, and disseminate data related to climate. By providing such data, CIS empowers a wide range of stakeholders, including farmers, policymakers, and businesses, enabling them to make informed decisions and implement adaptive strategies. This holistic approach not only streamlines risk mitigation but also cultivates resilience in the context of a dynamic climate, fostering the adoption of sustainable practices on a global scale. A Meta-analysis of literature was conducted to find out CIS practices, constraints faced by farmers to adapt CIS and suggestions given by them to formulate strategies for adoption and effective utilization of CIS. The current paper presents significance of climate information services to Indian agriculture, some initiatives and strategies to enhance adoption of CIS by farmers.

Key words: Climate Information Services, Indian Agriculture, Strategies, Adoption, Effective utilization

Evaluation of pigeonpea (Cajanus cajan l. Millsp.) varieties under different sowing dates

Bhimashankar M. Satale[1], Mirza I.A.B.[2], Priyanka Motinge [3]

Department of Agronomy, College of Agriculture, V.N.M.K.V., Parbhani - 431 402(M.S.)

Abstract

The field investigation entitled "Evaluation of pigeonpea (*Cajanus cajan* L. Millsp.) varieties under different sowing dates" was conducted during *kharif* season 2015-16 at experimental farm, College of Agriculture, Badnapur, VNMKV, Parbhani. The experiment conducted with four sowing dates in main plot viz., D_1 : (15^{th} June) , D_2: (30^{th} June) , D_3 : (15^{th} July), D_4 : (30^{th} July) and five varieties in sub plot viz., V_1-BSMR-736, V_2-BSMR-853, V_3-BDN-711, V_4-BDN-708 and V_5-VIPULA. Gross and net plot size viz., 7.2 m x 5.0 m and 5.4 m x 4.6 m respectively.

The soil was medium black, clayey in texture, alkaline in reaction and higher in total soluble salt concentration, low in nitrogen and phosphorus and rich in potassium and lime, alkaline in reaction with high base saturation. Sowing was done by dibbling method. From the result of experiment it can be concluded that, among different sowing dates for pigeonpea, the sowing at (15^{th}June) was found optimum for achieving higher seed yield. The pigeonpea variety BSMR-736 was found to be highly productive as compared to rest of the varieties.

Key words – Pigeon pea, Sowing date, varieties, yield, optimum time.

Effect of thermal treatment (parboiling) on the nutrient content, functional properties and storage stability of millets

[1]Aparna Kuna, [2]Lakshmiprasanna Kata, [3]Debjani Das*, [4]Md. Naseerunnissa and [5]Zubeda Sohan.

[1]Ph.D Principal Scientist & Head, MFPI, [2]Scientist (Seed Technology) MFPI – Quality Control Laboratory, [3& 4] Ph.D Scholar, Dept. Food and Nutrition, PGRC,-[5]Research Associate, MFPI PJTSAU, EEI Campus, Rajendranagar, Hyderabad

***Presenting and Corresponding Author -** dasdebjani038@gmail.com

Abstract

Objectives: To induce thermal treatment (parboiling) to the selected millets, to study the effect of heat treatment on the nutrient and anti-nutrient content and storage stability in selected millet samples.

Materials and methods: Analysis was conducted on untreated and thermally treated millet flours. The nutrient composition was estimated by analyzing moisture, protein, crude fiber and crude fat, carbohydrate and energy using standard methods. Anti-nutrient content, functional properties like water and oil absorption capacity, bulk density, least gelation concentration and foaming capacity were estimated using standard protocols. The flours were kept for storage study and the peroxide values and free fatty acids content was estimated during 1st and 2nd month of storage.

Results and Discussion: The fat content, carbohydrates and energy values of all parboiled samples were higher than the raw samples. The results indicate that parboiling improves the gel forming capacity of the flours as compared with raw flour. The results of anti-nutrient content indicate that, parboiling significantly reduced the anti-nutrients like phytates and tannins, indicating that parboiled millets could be better for usage in terms bioavailable minerals and other nutrients contained in the millet grains. It was observed that, there was an increase in the moisture, peroxide values and free fatty acids values among all the stored samples. However, in the parboiled samples, the increase was less compared to raw samples, indicating the significance of parboiling as a treatment to improve the shelf life of millets.

Conclusion: Millets are termed as ''yesterday's coarse grains and today's nutricereals''. Despite the numerous potential benefits, these crops have limited commercial demand, especially in the urban areas, due to rancidity issues leading to poor storage in the flours and other products prepared from them. However parboiling could be a potential low cost technology to ensure the storage stability of millets, as per the results obtained in our study.

Key Words: Millets, Thermal treatment, Parboiling, Nutricereals, climate-resilient agriculture.

Vulnerability to Climate Change in Himalayan Region of Uttarakhand

Dr. Rupan Raghuvanshi*
Subject Matter Specialist (SMS), Agriculture Extension, Krishi Vigyan Kendra, Barabanki,
**** Corresponding Authors email:*** *rupanraghuvanshi17oct@gmail.com*

Abstract

Climate change has emerged as a critical component in global development dialogue. It is of concern to the governments of developed countries as well as that of developing/ under-developed countries as it presents a major threat to sustainable development. Changes in climatic parameters will also have adverse impact on global food security. As we know India is an agriculture dependent country, climate change directly affects agriculture productivity. However, agriculture sector is inherently sensitive to climatic conditions and is one of the most vulnerable sectors to the risk and impact of global climate change. Agriculture is dependent on a proper combination of weather and associated factors, and is thus highly vulnerable to climate change. Thus, to have an insight into these issues a study was undertaken to assess the Vulnerability of farmers in Himalayan region of Uttarakand.

The analytical and descriptive research deign was used. It was found that majority of the respondents (52.5%) had medium level of risk perception about climate change. Further it was found that majority of the respondents (71.5%) had medium level of awareness about climate change, favorable attitude towards climate change (50%), adopt drought/frost tolerant variety(92.5%), had medium level of fatalism(66%), social cohesiveness(80%) and level of dependence of natural and social capital (63%). It was also found that farming experience, size of landholding, socio-economic status, information seeking behavior, attitude towards improved farm practices and attitude towards research station had significant positive relationship with the vulnerability of farmers to climate change.

This study help the scientist, planners and extension policy makers to frame the policies, location specific strategies according to the vulnerability level of farmers and promotes successful adaptation of agricultural practices at local level. There is a need to look into the policies for household food security enhancement and to minimize the climate change vulnerability.

Keywords: Climate Change, Farmers, Awareness, Vulnerability Assessment, Himalaya

Impact of Climate resilient Technologies in Nandyal district of Andhra Pradesh

*G. Dhanalakshmi *[1], B. Jamuna Rani **, M. Sudakar*[3]& A. Krishnamoorthy*

*[4]dhanaguru12@gmail.com

* Krishi Vigyan Kendra, Yagantipalle, **Director International Studies, PJSTSAU

Abstract

Climate change is a significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years. In developing countries, crops yield declines will be seen in important crops and South Asian countries will be particularly hard hit. Climate-smart agricultural technologies proved to be the best adaptation strategies followed by farmers for sustainable crop yields. Study on Impact of climate resilient technologies and factors associated in adoption of the technologies were conducted in Nandyal district of Andhra Pradesh. The results of the study indicated that Conservation furrows helped in increasing the yield of Setaria by 28% (1418kg/ha) and castor by 32 %(1332kg/ha) and in cotton it was 51% higher and in red gram it was 44% higher (1024 kg/ha). With micro irrigation yield was enhanced by 35 % in sweet orange (27t/ha), tomato 32 % (64t/ha) and in brinjal it was 41 % higher than control. In intercropping system of setaria with red gram in 5: 1 ratio 28 % more yields was recorded. In case of groundnut and red gram intercropping in 7:1 ration the yield recorded was 30 % more than the control. Drought tolerant varieties of Castor, Bengal gram and Groundnut recorded enhanced yield by 25 %,(1330kg/ha), 23% (1513kg/ha) and 50 % (1020kg/ha) respectively with additional net returns. Short duration varieties of Setaria, Groundnut and green gram yielded 32, 58 and 9 per cent more than the traditional varieties. Certain characteristics, viz., mass media exposure, Capacity building programs attendance, extension contact, perception on climate change and perception on climate resilient technologies had a significant correlation with the adoption of CRTs among the farmers.

Keywords: Climate resilient technologies, In-situe Moisture conservation, Intercropping, Short duration, Drought tolerant varieties and personal characteristics.

Ignoring Ecological Restoration – An Impediment in Regenerative Agriculture and Climate Change

Honnur Basha[1], Ajay Saraf [2], Vineet Chopra [3], Mohan Anjankar [4], Garth Watson[5] and Brian Blackburn[6]

[1]Executive Director and Operations officer, [2] Executive Director and Regenerative Agriculture Officer, [3] Executive Director and Business Development Officer, [4] Executive Director, [5] Chairman and Executive Officer, (India & Canada), [6] Executive Director and Communications Officer, (India & Canada), NATCAP Geoponix India Private Limited, Nagpur, India;

Corresponding Author: b.honnur@natcap.world

Abstract

Ecological restoration plays a crucial role in regenerative agriculture, contributing to farming practices' overall sustainability and resilience. By incorporating restoration practices, farmers can create agricultural systems that are not only productive but also environmentally friendly and capable of withstanding the current and future challenges of climate change. However ignoring ecological restoration in regenerative agriculture can have significant consequences for both the environment and the long-term sustainability of farming practices through loss of biodiversity, soil health decline, increased vulnerability to pests and diseases. Furthermore, ignoring also limits the potential of soil to act as a carbon sink and resulting in soil erosion, nutrient runoff, and contamination of water bodies. This aspect not only undermines the potential benefits of regenerative practices but may also exacerbate environmental degradation and impact the overall viability of agricultural systems. Hence, ecological restoration is to act as fundamental basis of regenerative agriculture as it addresses multiple facets of ecosystem health, sustainability, and resilience. Ecological restoration also enhances the aesthetic and cultural value of landscapes. It can contribute to the preservation of cultural heritage, provide recreational opportunities, and create aesthetically pleasing agricultural environments. This holistic approach aligns with the principles of regenerative agriculture, which emphasizes the integration of ecological, social, and economic considerations. This review aims to analyze the interconnectedness of these factors, emphasizing the importance of incorporating ecological restoration into regenerative agricultural strategies to achieve sustainable and resilient food systems while addressing climate-related issues.

Key words: Ecological restoration, Regenerative agriculture, Biodiversity, Climate change Soil health, Carbon sink

Smart Farming for a Changing Climate: Technology Solutions for Resilience

Jatin Jaiswal[1]*, Raghuveer Choudhary[1], Chirag A. Gorasiya[2] and Bhavik P. Solanki[1]

[1] Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat

[2] Department of Soil Science and Agricultural Chemistry, College of Agriculture, Junagadh Agricultural University, Junagadh Email: 13jatinjaiswal@gmail.com*

Abstract

As our climate undergoes unprecedented changes, agriculture faces new challenges that demand innovative solutions. This article explores the transformative role of smart farming technologies in bolstering the resilience of agricultural systems in the face of climate change. The integration of advanced technologies, such as precision farming, IoT (Internet of Things), artificial intelligence, and data analytics, offers a dynamic approach to enhance agricultural practices. Smart farming leverages real-time data to optimize decision-making processes, enabling farmers to adapt swiftly to shifting climate patterns. Precision agriculture, for instance, utilizes sensors and GPS technology to precisely manage resources, minimizing waste and maximizing efficiency. IoT devices provide continuous monitoring of environmental conditions, allowing farmers to anticipate and mitigate the impacts of extreme weather events. Artificial intelligence plays a pivotal role in predictive modelling, offering insights into climate trends and helping farmers make informed decisions about crop selection, irrigation, and pest control. The article delves into specific examples of smart farming applications, highlighting successful case studies where technology has significantly increased productivity while minimizing environmental impact. Furthermore, the article explores the potential of technology-driven solutions in fostering sustainable agricultural practices. The implementation of smart farming not only contributes to climate resilience but also promotes resource conservation, water efficiency, and biodiversity preservation. In conclusion, "Smart Farming for a Changing Climate" elucidates the promise and potential challenges associated with integrating technology into agriculture.

Keywords: Smart Farming, Climate Resilience, Precision Agriculture, Internet of Things (IoT) and Artificial Intelligence.

Root dynamics of Grape (vitis vinifera l.) Cuttings under Climate changing scenario of elevated Carbon Dioxide and Temperature

L. Shruthi Reddy* and Dr. A. Gopala Krishna Reddy[1]

*Ph. D Scholar, SKLTSHU, Mail: lattupallishruthireddy@gmail.com

[1]Senior Scientist (Horticulture), ICAR-CRIDA, Hyderabad

Abstract

Global climate change emerged as a major environmental challenge due to its potential impact on earth. The atmospheric CO_2 concentration is steadily increasing and has reached 404.31ppm at present. Elevated CO_2 is one of the main contributor to increase the temperature in the atmosphere causing global warming, hence interaction effects of elevated CO_2 (eCO_2) and elevated temperature (eT) on crop growth requires a research attention as they are susceptible to various environmental factors such as temperature, water availability, and CO_2.

An experiment was conducted to investigate the influence of eCO_2(550 ppm), eT(+3 °C) and interaction (eCO_2+ eT) on the growth and rooting of cuttings of three grape varieties (Thompson Seedless, Bangalore Blue and Dogridge) in specially designed OTC, FACE and FATE facilities at ICAR-CRIDA. Destructive sampling was done and number of days for bud break, root parameters (root number, root length, root diameter, root volume, dry weight of roots), shoot parameters (fresh weight, dry weight, root shoot ratio) and leaf parameters (number of leaves, chlorophyll content) were recorded. The data revealed significant differences between treatments, varieties, and their interaction for all the parameters studied.

The results of this study suggested that cuttings grown under eCO2 and eCO2+eT had positive effects on root length, leaf area, chlorophyll content, % survival, root volume and total biomass and was observed that, the root growth was better in eCO2 and eCO2+ eT than eT and control. The increase in dry matter and growth of root, shoot and leaves proved that eCO2 can stimulate photosynthetic rate which ultimately lead to an increase in biomass of crops. The overall experiment showed that, under elevated CO2 and elevated CO2 +eT, there was increase in root and shoot growth. Hence, increase in atmospheric CO2 and temperature associated with future climate is expected to affect rooting of grape cuttings.

Key words: elevated CO_2, elevated temperature, OTC, FACE and FATE.

Improving Soil Carbon Sequestration with Recommended Agricultural Management Practices.

Suraj Mishra1*, K. P. Pandey2, Veerendra Kumar Patel3, Vivek Kumar Singh3, Rahul Verma4

1. Research scholar, Department of Soil Science and Agricultural Chemistry, BUA&T, Banda (U.P.) India, Corresponding Author Email: surajmishras306@gmail.com
2. M.Sc. (Ag.), Department of Agronomy, BUA&T, Banda (U.P.) India.
3. Research Scholar, Department of N.R.M., MGCGVV, Chitrakoot, Satna (M.P.) India.
4. Research scholar, Department of Agronomy, BUA&T, Banda (U.P.) India.

Abstract

Climate change in India is threatening food security due to the tropical monsoon climate and the poor cropping capacity of small and marginal farmers. The Inter-Governmental Panel on Climate Change (IPCC) has projected a global mean surface temperature rise of 1.1–6.4°C by 2100. Soil carbon sequestration refers to the ability of agricultural lands and forests to reduce the amount of carbon dioxide from the atmosphere. Healthy soils can help combat climate change because soils having high organic matter can have higher CO2 sequestration potential. Improper soil and crop management practices have resulted in a continuous loss of soil carbon. Agricultural practices primarily responsible for soil carbon loss include improper tillage operations, crop rotation, residue management, fertilization, and low use of organic fertilizers, resulting in a continuous loss of soil organic matter in the form of CO2. The last two decades have seen a rise of interest in the adoption of recommended agricultural practices aimed at improving the sustainability of agricultural lands among smallholder farmers in developing countries. This paper set out to understand factors that influence the adoption of technologies that enhance soil carbon sequestration. The adoption of recommended agricultural management practices (RAMP) enhances carbon sequestration while reducing the rate of enrichment of atmospheric CO2. Such an increase can result from practices that include improved, conservational agriculture that focuses on crop residue management, manure and compost application and adopts several techniques like no-

Keywords: Atmospheric CO_2, Carbon Sequestration, Recommended Agricultural Management Practices, Soil health, Soil organic carbon

Evaluation of Key adaptive traits in Millets for Drought stress tolerance

[1]Srividhya S., [2]Swarna R., [3]Madhusudhana, R, [4]Seva Nayak, D.

[1,2,3,4] Scientist, ICAR- Indian Institute of Millets Research, Hyderabad- 500030

Corresponding author: *srividhya@millets.res.in*

Abstract

Sorghum is an important coarse millet grown in the arid and semi-arid regions of the globe. The post rainy (Rabi) crop of sorghum is ideally preferred for grains but it suffers moisture stress, at various critical stages, especially post - anthesis, due to the receding moisture conditions. The post - anthesis terminal drought intensity severely affects the grain development in sorghum. Therefore, the interrelations between soil moisture stress, photosynthesis and grain growth require critical investigation.

The present study is focused to identify key water use traits to be deployed in breeding programs that actually contribute for drought tolerance under varying moisture limited environments and to establish an association between above and below ground traits, their role in regulating yield potential. Hence, the study aimed to identify key adaptive traits using lysimeter contributing for drought tolerance and donors with better yield performance adapted to specific target environments to be employed in breeding programs. Outcome of study: Sorghum cultivars resilient to climate change and with 10-20 % high productivity, that can contribute to improvement in the livelihoods of poor and marginal farmers of drought prone areas.

Keywords: Climate change, Drought stress tolerance, Lysimeter, Sustainable crop production

Resource Conservation Technologies (RCTs) impact on yield of Wheat (*triticum aestivum*) in Bhopal District (M.P)

Neha Kushwaha*[1], Dilip Jat[2], KP Singh[3] and Satish Kumar Singh[4]

[1]Ph.D. Scholar, Department of Extension Education, JNKVV, Jabalpur (M.P.)

[2] Scientist (SS), ICAR-CIAE, Bhopal (M.P.)

[3] ADG, Farm Engineering, ICAR, New Delhi

[4]Senior Research Fellow, ICAR-CIAE, Bhopal, (M.P.)

**Corresponding author: singhneha3103@gmail.com*

Abstract

Resource conservation technologies (RCTs) offer chances to improve the productive utilization of resources, lower production costs, boost yields, diversify crop production, and benefit the environment. The current study was conducted to determine the yield gaps between improved packages and practices under Front line demonstrations (FLDs) of RCTs and farmer's practice (FP) of wheat crop, as well as an assessment of the energy requirements of the various planting techniques source and operation wise. The average extension gap, technology gap and technology index (%) were observed for the RCTs demonstrated. FLDs were carried out on 11 farmer's fields in order to illustrate the influence of improved agro-techniques on productivity. RCTs demonstrated were rotary broad-bed seed drill, broad-bed furrow-cum-seeder and strip-till-drill. The source wise input energy was highest in broad bed furrow-cum-seeder (21811MJ ha^{-1}). The total output energy of the crop production systems followed the order: rotary broad-bed seed drill (160016 MJ t^{-1}) > broad bed furrow-cum-seeder (150047 MJ t^{-1}) > strip-till-drill (143438 MJ t^{-1}) > seed drill (131124 MJ t^{-1}). Operation wise input energy was highest in seed drill (36858 MJ t^{-1}) followed by strip-till-drill (35788 MJ t^{-1}), broad bed furrow-cum-seeder (34051 MJ t^{-1}) and rotary broad-bed seed drill (33711 MJ t^{-1}) indicating that seed drill is the most energy-investment technology. The technology demonstrated at FLDs produced more yield than farmers' traditional practices. On an average, 21.94% increase in wheat yield can be obtained when seeded using rotary broad-bed seed drill compared to seed drill. The rotary broad-bed seed drill has the lowest technology index (8.95%) and technology gap (4.7q/ha), making it the most practicable technology. This study illustrates that with the adoption of a better-quality package of practices cost of production could be decreased and wheat productivity could be increased, which will boost the income of the farmers with better energy management.

Keywords: Energy; FLDs; RCTs; Seed drill

Adapting Agriculture to a Changing Climate: Challenges and Opportunities

[1]Raghuveer Choudhary, [2]Dr. P. D. Vekariya, [1]A. R. Ninama and [1]Jatin Jaiswal
[1]Department of Agronomy, College of Agriculture,
Junagadh Agricultural University, Junagadh, Gujarat
[2]Associate Research Scientist, Main Dry Farming Research Station,
JAU, Targhadia, Department of Agronomy, JAU, Junagadh
Email- raghuveerbajya63458@gmail.com

Abstract

Climate change poses unprecedented challenges to global agriculture, necessitating urgent adaptation strategies to ensure food security and sustainable production. This article explores the multifaceted challenges and opportunities associated with adapting agriculture to a changing climate. Rising temperatures, erratic precipitation patterns, and increased frequency of extreme weather events are among the primary challenges faced by farmers worldwide. These climatic shifts impact crop yields, water availability, and soil fertility, posing risks to livelihoods and global food systems. In addressing these challenges, opportunities arise for the development and implementation of innovative and climate-smart agricultural practices. Precision farming, drought-resistant crop varieties, and sustainable water management techniques are among the promising avenues for enhancing resilience. Policy interventions play a crucial role in fostering climate-resilient agriculture, and the article examines effective governance frameworks at local, national, and international levels. Additionally, it highlights the role of technological advancements, research, and knowledge-sharing networks in supporting farmers as they adapt to changing climatic conditions. Through an analysis of case studies and successful initiatives worldwide, this article provides insights into actionable strategies that mitigate the impacts of climate change on agriculture. It underscores the need for a holistic and collaborative approach involving farmers, policymakers, researchers, and communities to navigate the challenges and harness the opportunities presented by a changing climate. The findings contribute to the growing body of knowledge guiding efforts toward sustainable and climate-resilient agricultural practices.

Keywords: Agriculture, adaptation, climate change, food security, sustainable production etc.

Seeding the Future: Navigating Agriculture for a Climate-Challenged World

Amrit Warshini[1], Prof. R.K. Doharey[2], Dr. N.R. Meena[3]

[1] PhD Research Scholar, [2] Prof. & HOD, [3] Assistant Professor

1,2,3 Department of Extension Education, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya- 224229.

Email id: amritwarshini1996@gmail.com

Abstract

The stark realities of climate change are undeniable rising temperatures, increased frequencies of storms, relentless heat waves, and receding ice sheets. As a sensitive system, agriculture bears the brunt of these alterations, grappling with unpredictable rainfall patterns, extreme weather events (floods and droughts), and changing temperature regimes. To maintain agricultural health and productivity, resilience becomes paramount, encompassing both reduced greenhouse gas emission practices and adaptable strategies to navigate the evolving climate. Mounting evidence underscores the urgency of affordable adaptation solutions for irrigated agriculture, particularly as climate trends solidify and potential disruptions loom. Sustainable water management becomes crucial in the face of carbon emissions jeopardizing water supply reliability. Empowering smallholder farmers is equally vital; strengthening their responsive capacities, alongside fostering innovation, learning, and anticipatory approaches, equips them to withstand the impending climatic shifts. This paper delves into the impact of Climate-Smart Agriculture (CSA) innovations in building resilience within smallholder farming systems. While numerous adaptation options exist for irrigated agriculture, understanding existing measures to address emerging climatic risks and build resilience remains a crucial gap in the literature. This work bridges this gap, offering an economic analysis framework to identify cost-effective methods for bolstering the resilience of irrigated agriculture. Robust risk management, proactive disaster mitigation and early warning systems, adaptable strategies, comprehensive knowledge and training programs, informal safety nets, strong social networks, and optimized infrastructure utilization can all empower smallholder farmers to adopt CSA innovations, thereby enhancing their climate resilience. Consequently, policies that emphasize good governance, foster social cohesion, invest in disaster communication and early warning systems, ensure readily available drought-resistant varieties, provide climate-smart extension services, and prioritize climate-resilient infrastructure are critical for building a resilient agricultural landscape.

Key words: Climate Change, Adaptation, Mitigation, Resilience, Climate smart agriculture, Policies

Long-term effect of the conservation agriculture on crops yield and soil physical properties, and aggregate associated carbon in rainfed maize (*Zea mays*)-Pigeon pea (*Cajanus cajan*) crop rotation under red Alfisols

A.K. Indoria[1]*, G. Pratibha[1], V.K. Singh[1], S. Kundu[1], K. Sammi Reddy[2], K. Srinivas[1], M. Prabhakar[1], K. V. Rao[1], Munna Lal[1] and H. Sahu[1]

[1]*ICAR-Central Research Institute for Dryland Agriculture, Hyderabad, Telangana, India*

[2]*ICAR-National Institute of Abiotic Stress Management, Baramati, Maharashtra, India*

Abstract

This study was aimed to assess the impact of different tillage practices and nitrogen levels on crops yield, soil bulk density, total porosity, soil moisture content and soil aggregate associated carbon in maize-pigeonpea crop rotation. Treatments includes: three tillage practices i.e., conservation agriculture (CA), reduced tillage (RT) and conventional tillage (CT), and four nitrogen levels viz., control (N_0), 75% of the recommended dose of the nitrogen (RDN) (N_{75}), 100% of RDN (N_{100}) and 125% of RDN (N_{125}) of crops. Results showed that CA recorded 20-25% higher yields in maize and pigeonpea as compared to the CT. The added levels of the N significantly ($p \leq 0.05$) increased the crops yield. The significantly lower bulk density (15-20%) and higher soil total porosity (25-28%) recorded in CA as compared to the CT. The order of different size fractions with respect to carbon content was as follows: 0.106-0.053>0.5-0.25>0.25-0.106> 1-0.5> 2-1>4.75-2 mm> silt+clay. The significantly higher carbon stocks in different aggregate recorded under CA and in N_{125} as compared to the other treatment combinations. The higher soil moisture (10.71%) recorded under CA followed by RT (9.46%) and CT (8.48%) in soil profile (0-60 cm). The added level of the nitrogen decreased the soil moisture in soil profile (0-60 cm), i.e., N_0 (9.71%)>N_{75} (9.61%)>N_{100} (9.50%)>N_{125}(9.37%) during maize growing season. The results of the study conclude that long-term adoption of CA significantly improved the various soil properties in rainfed maize-pigeonpea crop rotation under red Alfisols and could be of paramount importance in a climate change scenario.

Keywords: CA, reduced tillage, conventional tillage, bulk density, aggregate carbon

Speed breeding to aid the Climate resilient Agriculture

Deepika. C
Scientist, ICAR-Indian Institute of Millets Research, Hyderabad
deepika@millets.res.in

Abstract

Breeders and scientists are continuously looking for ways to increase genetic gain in crop breeding to meet the challenge of feeding a growing population. The way this can be achieved is through 'speed breeding' (SB), a technique which shortens the breeding cycle and accelerates research studies through rapid generation advancement. Modern crop breeding and advances in management practices have contributed substantially to the annual gain of 0.8–1.2% in crop productivity. Nevertheless, this current rate of improvement is not sufficient to keep up with food and biofuel demands for the projected global population in 2050.Speed breeding uses extended photoperiods and controlled temperature regimes to achieve rapid generation cycling in fully enclosed growth rooms or glasshouses for large-scale application in crop breeding programs. This provides a highly flexible platform to achieve rapid generation advancement, irrespective of genetic background, where up to four to seven generations per year can be achieved. This holds significant promise, not only to rapidly develop populations for genetic studies, but also, for introgression of favorable alleles into elite germplasm for crop improvement which ultimately reaches the farmers' fields in short period of time when compared with conventional breeding.

Key words: Speed breeding, climate resilient, rapid generation advancement, agriculture

Role of Microbes in Abiotic Stress Management

K. P. Pandey1, Suraj Mishra2 and Aniket H Kalhapure3
Corresponding Author Email: kamtapandey2000@gmail.com
1. M.Sc. (Ag.), Department of Agronomy, BUA&T, Banda (U.P.) India.
2. Research scholar, Department of Soil Science and Agricultural Chemistry, BUA&T, Banda (U.P.) India
3. Assistant Professor, Department of Agronomy, BUA&T, Banda (U.P.) India.

Abstract

Agricultural production contributes heavily to global food security, and the region's crops are under serious threat, including poor soil quality, biotic and abiotic stresses, as well as changing climatic conditions. The abiotic stress factors include severe temperatures, droughts, stagnation, environmental contaminants, and salinity. Under these environmental pressures, plants experience

35

a variety of physiological, molecular, and biochemical changes that affect the overall growth and development of the plant. To deal with such repercussions, various adaptations and mitigation techniques are needed. Microorganisms are the most effective tool that could play a vital role in adaptation strategies and increase the tolerance to abiotic stresses in agricultural plants. Plant growth-promoting bacteria are among the beneficial microbes that present the best chances for widespread application in agriculture to control soil quality and other parameters that correlate to the restricted growth and yield output of key field crops. Through the synthesis of exopolysaccharides and the creation of biofilms, plant-growth-promoting Rhizobacteria (PGPR) can most effectively reduce the negative effects that abiotic stimuli such as drought, low temperature, salinity, and high temperature have on plants. PGPR mitigates the impact of drought on plants through a process so-called induced systemic tolerance (IST), which includes: a) bacterial production of Cytokinins, b) production of antioxidants, and c) degradation of the ethylene precursor 1-aminocyclopropane-1-carboxylic acid (ACC) by bacterial ACC deaminase. Additionally, endophytic Rhizospheric bacteria and arbuscular mycorrhizal fungi tend to lessen abiotic stress in plants. Use of these microorganisms per se can alleviate stresses in crop plants thus opening a new and emerging application in agriculture. These microbes also provide excellent models for understanding the stress tolerance, adaptation and response mechanisms that can be subsequently engineered into crop plants to cope with climate change-induced stresses.

Keywords: Abiotic stress, Agriculture Production, Drought, Microorganisms, Salinity

50

Breeding for farmer's preferred traits in post rainy sorghum by using MAGIC Approach

Parashuram Patroti[1*], R. Madhusudhana[2], Baswaraj Raigond[1], S. Srividhya[3], G. Shyamprasad[3], D. Balakrishna[3], Malika Nadaf[1], Sadaf Deshmukh[1], Y. S. Kshirsagar[1] and C. Tara Satyavathi[3]

[1]*ICAR-Indian Institute of Millets Research, Regional station, Shelgi, Solapur, Maharashtra, India.*

[2]*Pro*ject Co-ordinating Unit, *AICRP on Sorghum & Millets, ICAR-Indian Institute of Millets Research, Rajendranagar, Hyderabad, Telangana, India.*

[3]*ICAR-Indian Institute of Millets Research, Rajendranagar, Hyderabad, Telangana, India.*

***Corresponding author's email:** parashuram@millets.res.in; parashuram.patroti@icar.gov.in*

Abstract

Post rainy (rabi) sorghum grown under rainfed conditions often suffers from various biotic and abiotic stresses resulting in considerable grain yield losses. Post rainy sorghum mostly preferred as a dual-purpose crop due its excellent grain and fodder quality. Development of any production technology or improved variety / product in a crop commodity like post rainy season sorghum should have a more farmer centric approach and focus on farmers preferred traits. High grain and stover yields along with bold and lustrous grains, better fodder quality, tolerance to insect-pest (shoot fly & stem borer), diseases (charcoal rot and rust) and drought tolerance (stay green) are some of the most preferred traits by the farmers. Hence, developing a variety or a line with multiple traits becomes more important and rewarding to the farmers in terms of better productivity and market value.

Plant breeders have routinely used bi-parental crosses (single crosses between two parents) for sorghum varietal development. But this approach shows less variability and few recombination events leading to only few trait combinations. To overcome these challenges multi-parental cross populations (MAGIC -Multi-parent Advanced Generation Inter-Crosses) were tried to realize better transgressive segregants and to isolate superior genotypes. Eight diverse parents belonging to different rabi ecologies, were crossed for three consecutive years from 2016 to 2018 by following a pair-wise mating, their derivatives were advanced to subsequent generations and stabilized lines were tested both under station and multi-locations trials under AICRP.

Results from preliminary yield evaluation trials conducted at ICAR-Indian Institute of Millets Research, regional station, Solapur revealed that, the double cross (4 parents) and quadruple cross (8 parents) derivatives were found promising for multiple rabi adaptive traits. The lines *viz.*, CRS-Sor-12 [(CSV 26 x Phule Suchitra) x (DSV 5 x Phule Revati)] and CRS-Sor-13 [(Phule Anuradha x Parbhani Moti) x (CSV 216R x CRS 4)] were superior for grain and stover with 20-25% and 18-22% yield advantage over the ruling check CSV 29R respectively.

Besides yield, these lines are also found to be tolerant to shoot fly, stem borer, charcoal rot, rust and drought (transpiration efficiency, high SPAD).

Moreover, one of the multi-parent cross derivative SPV 2918/CRS105 [{(M35-1 x CSV 29R) x (Parbhani Moti x CRS 20)} x {(DSV 5 x Sel. 3) x (CSV 216R x CRS 4)}] has been promoted to final stage of testing under AICRP system, because of its advantage over the national check for most of the farmer's preferred traits.

It has bold and lustrous grains, less shoofly (-5.48%) and charcoal rot incidence (CRI: 15.65%), stay green and non-lodging compared to national check CSV 29R. Such a package of useful traits in the background of high yielding cultivars will lead to better adaptation, area expansion and climate resilient- sustainable production system post rainy season sorghum.

Key words: Post rainy sorghum, Farmer's preferred traits, MAGIC, Multiple traits, Climate resilience

Increasing cropping intensity through conservation agriculture in Rain-fed Pearl millet based cropping system in Semi-arid Alfisols

Sumanta Kundu[1], V.K. Singh[1], G. Pratibha[1], JVNS. Prasad[1], A.K. Indoria[1], V. Girija Veni[1], B. Pooja[1], Ch. Chandra Sekhar[1], I. Srinivas[1], KV Rao[1], Ch. Srinivasarao[2]

[1]ICAR- Central Research Institute for Dryland Agriculture, Santhoshnagar, Hyderabad, Telangana, India,

[2]ICAR- National Academy of Agricultural Research Management, Rajendranagar, Hyderabad, Telangana, India, *Corresponding Author: Sumanta Kundu, Email: sumanta.k@icar.gov.in

Abstracts

Developing new conservation agriculture (CA) practices based on local soil, crop and climatic condition is very much needed to optimize resource use and combating land degradation. In Alfisols of semi-arid southern India, a single crop in the monsoon season is common. But growing short duration variety/hybrid of millet followed by short duration drought hardy legume like horse gram by utilizing the September rainfall and offseason rainfall is feasible for cropping intensification. A field experiment was conducted every year since 2016 in sandy loam soil of Gunegal Research Farm at ICAR-Central Research Institute for Dryland Agriculture (ICAR-CRIDA), Hyderabad with different tillage and nutrient management treatments to study the effect of tillage practices and different doses of fertilizers on performance of pearl millet (MP MH21) and horse gram (CRHG 4). Short duration (75-80 days) pearl millet (MP MH21) was selected to take the advantage of early sowing of horse gram. Significantly higher pearl millet equivalent yields were obtained in minimum tillage (MT) with 125% recommended dose of fertilizers compared to conventional tillage (CT) and zero tillage (ZT). Yield increase in MT was 13% over CT. ZT require 12.6% lower energy input over CT and MT. ZT recorded 23.27% and 11.75% higher energy output compared to CT and MT which indicate higher energy use efficiency. With better soil moisture conservation in MT and ZT, and effective use of September rainfall it is possible to get a good crop of horse gram which increased the cropping intensity and overall system productivity, profitability, nutrient and energy use efficiency.

Key words: Energy use efficiency, system productivity, minimum tillage, nutrient management

Effect of thermal treatment (parboiling) on the nutrient content, functional properties and storage stability of millets

[1]Aparna Kuna, [2]Lakshmiprasanna Kata, [3]Debjani Das*, [4]Md. Naseerunnissa and [5]Zubeda Sohan.

1Ph.D Principal Scientist & Head, MFPI, [2]Scientist (Seed Technology) MFPI, [3&4] Ph. D Scholar, Dept. Food and Nutrition, PGRC, [5]Research Associate, MFPI **- Quality Control Laboratory Prof. Jayashankar Telangana State Agricultural University, EEI Campus, Rajendranagar, Hyderabad.**

Abstract

Objectives: To induce thermal treatment (parboiling) to the selected millets, to study the effect of heat treatment on the nutrient and anti-nutrient content and storage stability in selected millet samples.

Materials and methods: Analysis was conducted on untreated and thermally treated millet flours. The nutrient composition was estimated by analyzing moisture, protein, crude fiber and crude fat, carbohydrate and energy using standard methods. Anti-nutrient content, functional properties like water and oil absorption capacity, bulk density, least gelation concentration and foaming capacity were estimated using standard protocols. The flours were kept for storage study and the peroxide values and free fatty acids content was estimated during 1st and 2nd month of storage.

Results and Discussion: The fat content, carbohydrates and energy values of all parboiled samples were higher than the raw samples. The results indicate that parboiling improves the gel forming capacity of the flours as compared with raw flour. The results of anti-nutrient content indicate that, parboiling significantly reduced the anti-nutrients like phytates and tannins, indicating that parboiled millets could be better for usage in terms bio-available minerals and other nutrients contained in the millet grains. It was observed that, there was an increase in the moisture, peroxide values and free fatty acids values among all the stored samples. However, in the parboiled samples, the increase was less compared to raw samples, indicating the significance of parboiling as a treatment to improve the shelf life of millets.

Conclusion: Millets are termed as ''yesterday's coarse grains and today's nutricereals''. Despite the numerous potential benefits, these crops have limited commercial demand, especially in the urban areas, due to rancidity issues leading to poor storage in the flours and other products prepared from them. However parboiling could be a potential low cost technology to ensure the storage stability of millets, as per the results obtained in our study.

Key Words: Millets, Thermal treatment, Parboiling, Nutricereals, climate-resilient agriculture.

Sustainable agriculture practices for food security

Weather-Responsive Farming: Harnessing Precision Agriculture for Climate Resilience

Jaykumar B. Gajera*, Dr. S. P. Kachhadiya and Sneh J. Devra*****

* Corresponding Author

*Ph. D. Scholar, Department of Agronomy, College of Agriculture, **Associate Research Scientist, Main Oilseeds Research Station, *** Research Scholar, Department of Agricultural Statistics, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat)

***Corresponding Author email id & mobile no.:** jay.gajera@yahoo.com* & +91-9601575626

Abstract

Climate-responsive farming, or climate-smart agriculture, is a strategy that optimizes agricultural productivity while minimizing the negative impacts of weather variability and climate change. It involves integrating specific weather conditions and forecasts into decision-making processes, such as crop selection, planting schedules, irrigation, and pest control. This approach enhances farmers' resilience to climate-related risks, ensuring sustainable food production in the face of evolving climatic conditions. As climate change threatens agriculture, livelihoods, and global food security, climate-smart agriculture is crucial in addressing these challenges. Climate resilience practices, such as agroforestry, crop diversification, precision farming, and technological advancements, are essential for food security, economic benefits, environmental sustainability, and social equity. Precision agriculture, a key element of weather-responsive farming, uses advanced technologies like sensors, drones, and AI to optimize farming practices based on real-time data. Successful case studies from Australia, Brazil, and the Netherlands demonstrate the potential of precision agriculture in reducing resource usage, improving crop quality, and mitigating environmental impact. Future trends involve integrating AI, machine learning, and drone technology into weather-responsive farming systems. The significance of using precision agriculture as a proactive strategy to address the issues brought on by climate change in agricultural systems is emphasized, as is the possibility for weather-responsive farming to improve climate resilience.

Key words: Climate resilience, Sustainability, Weather-responsive farming, Precision agriculture, Weather monitoring

Tilapia-Sugarcane Integration Paving the Way for Sustainable Prosperity

Shyam Datta Waghmare, Swadesh Prakash*, Kishor Kumar Krishnani, Arpita Sharma, Vinod Kumar Yadav, and Neha Qureshi

FEES Division, ICAR-CIFE, Mumbai

Corresponding author: swadeshprakash73@gmail.com

Abstract

Aquaculture is vital to global food production, addressing food and nutritional security. India has seen a significant rise in aquaculture production, particularly in Tilapia fish farming, supplying crucial animal protein for human consumption. However, studies on efficient water use and quality management are lacking. Farmers near the Ujjani reservoir in Maharashtra combine aquaculture with crop farming, integrating sugarcane cultivation with water discharged from tilapia farms. This study assesses the impact of fish farming on water quality in Tilapia fish farms within the Ujjani reservoir's commanding area. Ten tilapia fish farms were chosen, each with two sampling points: one upstream and another downstream from the fish farm discharge point. The monthly water samples collected from the selected tilapia fish farms and parameters like pH, temperature, turbidity, dissolved oxygen, chemical oxygen demand, nitrite-N, total ammonia-N, nitrate-N, hardness, alkalinity, calcium, sodium, and potassium were measured. The analysis involved a student's t-test for paired samples to assess the correlation between inlet and discharge water parameters. Results showed a positive correlation between discharge water and inlet water parameters, except for temperature and alkalinity. Significant differences ($p<0.05$) were observed between the inlet and discharge water in 13 water quality parameters. Integrated sugarcane farming with tilapia farm discharge water proves both environmentally beneficial by improving water quality and economically advantageous by reducing costs and increasing productivity.

Keywords: Monosex tilapia culture, Discharge water, Water quality, Student's t-test

Climate Resilient Backyard Poultry Farming as a Source of Income for the Farming Community of Ladakh.

F.D Sheikh, Sabiya Asmat, Kunzang Lamo, Rigzin Safal, J. Laskit, Stanzin Dorjay and Sonam Landol

Krishi Vigyan Kendra-Leh 1, SKUAST-K; UT-Ladakh

Abstract

Backyard poultry production among rural farmers of Ladakh was a part of an age-old natural farming practice like other parts of our country. It is the most cost-effective way for rural farmers to double their income within a short period of time with minimal input. Under the present climate change scenario in Ladakh with more precipitation and warmer winter a trial to study the performance of Vanraja (Backyard poultry breed) was carried out at KVK-Leh.

A total of 500-day old chicks were procured and were raised in a clean hygiene management. The birds were fed brooder mesh for two weeks and Starter mesh afterwards up to 44 days. After 44 days locally made feed (crushed barley, Maize, Pea) were fed the locally made feed was reduced to 50% and the birds were raised on the alfalfa fodder land.

The average body wt. for female birds at 2 weeks, 4 weeks, 6 weeks, 13 weeks, 26 weeks and 40 weeks age were recorded as 214±8.12 gm, 470±12.3 gm, 634± 11.43 gm, 1040± 15.32gm, 1430± 17.98gm and 2328±21.21 gm respectively. The average body wt. for males 2 weeks, 4 weeks, 6 weeks, 13 weeks, 26 weeks and 40 weeks age were recorded as 269±9.74 gm, 522±5.43 gm, 765± 10.65 gm, 1263± 12.32gm, 2437± 16.65 gm and 4104±23.32 gm respectively. The birds start laying at the age of 172±2.72 days.

The average egg production was 87± 3.26 eggs per bird in 500 days. The average egg weight was 54.47±1.73. The overall mortality was less than 10 percent. By this Model trial we were able to raise Van Raja successfully on range system as back yard poultry under cold arid condition of Ladakh. The Alfalfa Poultry Model is an enterprise with low initial investment but higher economic returns and can easily be managed by women, children and old aged persons of the households.

This farming model- Alfalfa Poultry Model can become a flourishing business for the farmers of Ladakh in near future under present climate change scenario.

Key Words: Alfa Alfa, Backyard Farming, Ladakh, Poultry, Vanraja.

Theme 4: Gender and Nutritional Security

Key note speaker for Theme 4

Dr.Sugandha Munshi, Ph.D.
Lead Specialist
Senior Associate Scientist I
Sustainable Impact Platform
International Rice Research Institute,
New Delhi

Equitable Food and Nutritional Security: A New Normal!

"Gender matters when we wish for food security and nutrition for all." Nutritious food on everyone's plates is an essential parameter to make this world a better place. For feeding the world population of 9.1 billion people by 2050, it is imperative to put our efforts together to end global hunger and secure inclusive food and nutritional security for all. It is important to understand that gender inequalities pose a challenge to attaining global food security and adequate nutrition in addition to climate variabilities and extreme weather conditions.

Out of the total population of the world, almost half of it lives in rural areas. It is estimated that the major source of livelihood for one-third of the world's population is dependent on agriculture and out of this Asia has the largest population dependent on agriculture. Hence, there is a need to innovate and develop a sustainable agri-based food systems that aim towards inclusive food security and nutritional diversity.

Traditionally, women are mostly dependent on natural resources and are more vulnerable to climate stresses. This increases the chances of women being more exposed to climate shocks and hampers their food, nutrition, and livelihood security. Convergence between various stakeholders in agri-based food systems can act as a catalyst for mainstreaming women in agriculture, providing them with an equal level playing field, and finally addressing food security and nutrition both at their household and community levels.

Though women contribute significantly to agricultural production, their contribution remains invisible. Furthermore, women are often excluded from decision-making on access to and the use of land and resources critical to their livelihoods.

Establishing a resilient agriculture and food systems with a focus on women's needs and aspirations is the need of the hour. There is a pressing need to design and implement strategies that consider and cater to the subjective socio-economic and biological differences among men and women as contributors in production and nutrition. Capacity building and training programs for both men and women focusing on climate resilient technologies, nutrition education, gender equitable consumption practices sources, and food value chain is crucial.

If we delve deeper, women are at an exceptional place in their households to ensure the nutritional intake of the family members, especially children. There is an inherent need for empowering women with access and ownership to productive resources like land, water, seeds, machinery, and nutritional information that cater to food security and nutritional outcomes both at the household and community levels. With increasing control over resources and income generation opportunities, they have a positive impact on increasing agriculture productivity and ensuring additional nutritious food availability in their household. Further, a behavioral change package of practices on gender equitable consumption practices is required. When women have an equal level playing field, access, and control over resources and incomes they contribute significantly to food security and nutrition at their household level. It is well established that to ensure nutrition at the household level women plays the role of a catalyst.

Pieces of evidence show that there is an active role of women in positively influencing household nutrition intake. In today's era of the digital world, it become more important to remove the gender digital divide for equal access to information. It is important to empower both women and men with the knowledge of the four pillars of food and nutrition security, which are food availability, access to food, utilization, and stability can play a crucial role in attaining the larger goal. Convergence between the various stakeholders - government bodies, private players, research institutes, developmental organizations, self-help groups, and women-based organizations can create momentum for an inclusive effort towards achieving the goals of food security and nutrition for all. A holistic approach towards nutrition-sensitive agriculture is the way forward.

The pivotal role played by the National Institutes of Agriculture Extension Management (MANAGE) effectively managing the extension system in the country can play a transformative role as the epicenter for designing gender-responsive interventions leading to policy reform for an equitable agri-based food system securing food and nutrition for all through targeting both men and women. The conference with participants from various fields of expertise will help in identifying the challenges, innovations, and solutions aiming toward an inclusive approach to attaining food security and nutrition for all.

Agri-Nutri (a2n) Smart village index (ansvi): A Mixed method approach

Sai Priyanka, Pagadala[8]*, V. Sangeetha[9], V. Lenin[3], L. Muralikrishnan[4], P. Venkatesh[5] & G.K. Jha[6]

Ph.D scholar[1], Senior Scientist[2], Principal Scientist[3], Scientist[4],Division of Agricultural Extension, Senior Scientist[5], Division of Agricultural Economics, ICAR-IARI, New Delhi, Principal Scientist & Head[6], Bioinformatics, IASRI, New Delhi

*pagadalasaipriyankanaidu@gmail.com +91-9492340019

Abstract

Agri-Nutri (A2N) Smart model village, is a community-driven, multi-sector approach, with objective to promote sustainable farming practices, enhance food security, and elevate the overall nutritional well-being of the village. To define the key indicators for assessing its progress and success, thematic analysis with independent coding was conducted and resulted in 61 indicators under 6 thematic areas encompass nutri-farming, innovative technologies, health and nutrition, economic and social inclusivity, as well as environmental considerations. Q-sorting the indicators with experts was done and subsequent indictors were subjected to Principal Component Analysis identifying 12 broad dimensions, including 40 measurable indicators to gauge the concept's effectiveness. These indicators were rigorously validated in three model and three non-model villages, drawing from two distinct agro-climatic regions of Uttar Pradesh and Telangana. The study involved 360 farmers i.e., 30 from each village and employed an index developed through the Alkire-Foster method of counting to validate the indicators. The findings have highlighted that nutrition and education, as well as smart technology adoption, as major determinants for proportional non-Agri-Nutri Smart (A2NS) status of farmers and gender empowerment emerged as a contributing factor for inadequacy in non-model villages. This approach to developing A2N Smart village index (ANSVI) holds the potential to understand nutritional vulnerability of villages and provides for tailor made strategies to be implemented for achieving A2NS status. Moreover, targeted up scaling of this framework through interventions such as capacity building, provision of nutrition education, and policy support can drive behavior change and lead to nutrition security within villages.

Key Words: Model Village, Thematic Analysis, Q-Sort, Indicators, ANSVI, Nutrition education

Global Best Practices in Nutrition Education to Alleviate the Triple Burden of Malnutrition

Deepthi Harkar
Affiliations: MS RDN LDN

Abstract

With the triple burden of malnutrition existing in households and communities worldwide, access to nutritious food remains a major concern for global food security. Rapid changes in people's diets and lifestyles, both in rural and urban settings, have a tremendous impact on the overall well-being of the population. In comparison to men, women are at a higher risk of developing obesity, malnutrition, and other nutritional deficiencies. According to the World Health Organization

(WHO), reducing the prevalence of chronic diseases by 5% annually will translate into savings worth US$430 billion in costs every year between 2020 and 2060. Food and nutrition education play a pivotal role in reducing this burden. Educating households, especially women, to make optimal use of local foods and follow healthy eating patterns by focusing on traditional practices can help prevent or cure illnesses caused by malnutrition and combat diet-related diseases.

Nutrition education will also help them understand the nutritional value of foods, food quality and safety, preservation methods, processing and handling, food preparation, and eating habits. This presentation will focus on global best practices that can be used to educate households, particularly women, on nutrition and wellness education, thus helping them reduce their risk for the triple burden of malnutrition.

Key words: Triple burden of Malnutrition, Food Security, Gender, Nutrition Education, Best Practices

Can Gender Equality Drive Us Towards Zero Hunger?

Kashmiri Jadhav[1], Rupesh Vyas[2], Sagar Deshmukh[3*], Vijayendra Kumar G[4]

[1&2] Consultant, [3*] Assistant Director, National Institute of Agricultural Extension Management (MANAGE) Rajendra Nagar, Hyderabad

[4]Professor, School of Business, Woxsen University, Hyderabad

Corresponding author – sag.deshmukh@manage.gov.in

Abstract

Zero Hunger and Gender Equality are two Sustainable Development Goals that are deeply interconnected. This article explores how gender mainstreaming, the process of integrating a gender perspective into all policies and practices, plays a vital role in achieving food security, which is the focus of Zero Hunger. We look at the history and development of these concepts, showing how they are linked. Our research reviews studies that show the positive effects of gender perspectives in food security initiatives.

We find that when women are given more opportunities in agriculture, there are significant improvements in farm productivity, household nutrition, and overall economic empowerment. However, there are still challenges. Cultural barriers, gaps in policy, limited access to resources, and a lack of data that takes gender into account are all obstacles that need to be overcome. To address these issues, we suggest several key steps.

Policies in agriculture should consider gender differences, data collection needs to be more gender-aware, and women's roles in decision-making should be strengthened. Our review also points out the need for more research to understand better the relationship between gender and food security. In a nutshell, this article highlights the importance of considering gender in efforts to achieve food security. It contributes to the discussion on these critical Sustainable Development Goals, showing that success in these areas is not just about providing food or promoting equality, but about integrating these goals to create a more sustainable and equitable world.

Keywords: Gender equality, Zero Hunger, Food Security**,** Sustainable Development Goals, Gender Mainstreaming

Cultivating Flavour: Innovating and Standardizing Microgreen Recipes for Nutritional Security

Veenita Kumari[1], Shirisha Junuthula[2]

[1] Deputy Director (Gender Studies), [2] MANAGE Fellow, Centre for Gender in Agriculture, Food and Nutritional Security, Urban Farming (CGANSUA), National Institute of Agricultural Extension Management (MANAGE) Rajendranagar, Hyderabad- 500 030, Telangana, India

Abstract

Microgreens, characterized by their small size and rich nutritional content, offer nearly 40% more vital nutrients than their mature counterparts, positioning them as a burgeoning functional food with significant health benefits. This study focuses on the development and standardization of microgreen recipes in India, aiming to assess their nutritional quality and sensory appeal. Six recipes, including uthappa, pulav, Potato Tikki, idli, sarvapindi, and sweet potato, were meticulously crafted, with standardized procedures ensuring consistent taste.

Sensory evaluation, involving 15 subjects, affirmed the acceptability of all microgreen-infused recipes. The nutritional analysis, conducted in both raw and cooked forms, revealed substantial amounts of macronutrients (total fat, proteins, and carbohydrates) and micronutrients (B2, B3, B5, B6, and vitamin C) in the microgreen-enhanced dishes.

The findings underscore the potential of microgreens not only as nutrient-dense additions to culinary creations but also as a solution for pesticide-free vegetable consumption. While existing research has explored the nutritional benefits of microgreens, this study emphasizes the imperative for developing ready-to-eat microgreen products.

Future research should prioritize enhancing the safety, shelf life, and overall quality of these products, fostering a broader understanding of their bioavailability and bioactivity in human diets. This investigation sets the stage for further academic and scientific exploration, recognizing the significant role microgreens can play in advancing healthy diets.

Keywords: Culinary Innovation, Microgreens, Nutritional Quality, Sensory Evaluation.

Nutritional status and physical activity pattern of Rural farm women

Rashmi Singh[1] and Deepti Singh[2]

[1]Department of Food Science and Nutrition, College of Home Science, CSAUA&T, Kanpur (U.P.)

[2] SMS Home Science, KVK Agra (U.P.),

Contact Number- 9628574203, Email address- rsingh.csauk@gmail.com

Abstract

Women regarded as "Creator of all green things". Besides performing domestic duties she provides crucial support to the family through the earning wages doing labor and carrying out household production activities. Agriculture is the largest industry in India and women constitute 50 per cent of the agricultural work force in our country. Women participate in almost all agricultural operations and recognized as backbone of Indian agriculture.

The present study was conducted to assess the nutritional status and physical activity pattern of rural farm women of Kanpur district. To achieve the objective of the study sixty farm women from *singhpur* village were selected. Information regarding general profile, nutrient intake by 24 hour recall method was collected. Measurement of body weight, height, MUAC, waist and hip circumference were recorded (Gibson, 1990).

Physical activity pattern of subjects was assessed by IPAQ and 24 hour physical activity recall method. Statistical analysis of the data was done and the result revealed that daily average nutrient intake of farm women was found to be less than RDA. Mean Body Mass Index (BMI) was found to be 19.39± 1.52 which indicates energy deficit in rural farm women studied. Physical activity pattern revealed that rural farm women perform various activities related to agriculture; it was found that they spend maximum time in harvesting of crops during season.

The study concludes that it is required to raise the nutritional status of farm women so that their efficiency can be increased.

Key words: Farm Women, Nutritional Status, Physical Activity, Anthropometry, Nutrient intake

Enhancing Cereal Nutrition through Agronomic Biofortification with green synthesized Nano Iron for Anemia Mitigation

Akshay Kumar Kurdekar[1] B. K. Desai[2] and Vishwanatha S Naik[3]

[1&2] Department of Agronomy, [2]Director of Research, University of Agricultural Sciences, Raichur, Karnataka 560 065, India

Abstract

This study explores a ground-breaking approach to tackle the pervasive issue of Anemia by enhancing cereal nutrition through agronomic bio-fortification with green-synthesized Nano iron. Anemia, prevalent in resource-limited regions, necessitates sustainable interventions, and this research proposes an innovative solution that marries advancements in nanotechnology with eco-friendly practices. The core methodology involves integrating bio-fortified cereal varieties with nano iron synthesized through environmentally conscious methods. The green synthesis, utilizing plant extracts or other ecological sources, not only ensures reduced environmental impact but also aligns with sustainable agricultural principles. The agronomic bio-fortification process, encompassing the cultivation of bio-fortified cereals and the application of green-synthesized nano iron, aims to boost iron absorption and accumulation in cereal grains. The reduced particle size of nano iron facilitates enhanced nutrient uptake by plants, contributing to increased iron content in edible parts. Rigorous field trials assess the effectiveness of this approach, examining nutritional profiles, soil health, crop yield, and the prevalence of anemia in target populations. Crucially, community engagement and education initiatives underpin successful implementation, empowering local farmers with knowledge about the benefits of bio-fortified cereals and the environmentally friendly aspects of green-synthesized nano iron. Collaboration with diverse stakeholders amplifies the study's impact, fostering scalability and collective commitment to combating anemia. This research not only advances the scientific understanding of agronomic bio-fortification but also underscores its potential as a sustainable, community-driven solution to address the complex challenge of anemia on a global scale.

Key words: Anemia, Nano iron, green synthesized and bio fortification

Gender and Food & Nutrition Security

[1]Swapnamay Ghosh, [2]Ashokkumar, and [3]Akkamahadevi Naik

1. PG Scholar, Assistant Professor, Department of Agricultural Extension Education M. S. Swaminathan School of Agriculture, CUTM, Paralakhemundi, Odisha. -761211

*Corresponding author email: ghoshswapnamay1817@ gmail.com, Mobile: 7001836149

Abstract

Due to the widespread prevalence of hunger and malnutrition, global attention has long been focused on ensuring food and nutrition security (FNS). Recently, there has been an increased recognition of the crucial role played by women in guaranteeing FNS within families. Various forums have discussed the specific FNS-related tasks that women exclusively undertake in a subtle, family-centered manner. Despite these discussions, many countries still lack the necessary legislative frameworks to empower women with legitimate control over both land and financial resources.

The strength of this approach is evident in its emphasis on facilitating women's access to land and natural resources, a factor that can greatly empower women in terms of food production and procurement. However, its weaknesses become apparent in its oversight of the challenges faced by women farmers in terms of production constraints. Additionally, it falls short in acknowledging the significance of forests and fisheries as crucial food sources.

The strategy lacks clarity on the specific natural resources that women require access to and the reasons behind such necessities. Addressing the global challenge of sustaining food security and ensuring sufficient nutrition is crucial. The G20 countries, which account for two-thirds of the world's population, shoulder half of the global malnutrition burden, manifested in either excessive or insufficient nutritional intake.

The overarching risks linked to food insecurity, such as climate change, ecological concerns, and resource limitations in relation to a growing population, are macro-level challenges associated with the global commons. This article explores several key gender-sensitive aspects of FNS management, shedding light on the need for a comprehensive range of policy interventions centered around women to achieve FNS at a significant scale.

Keywords: Agriculture, Food, Gender, Nutrition, Livelihood security.

Gender and the Double-Edged Plate: Unraveling the Interwoven Threads of Food and Nutrition Security

Amrit Warshini[1], Prof. R.K. Doharey[2], Dr. N.R. Meena[3]

1 PhD Research Scholar, 2 Prof. & HOD, 3 Assistant Professor,

[1,2,3] Department of Extension Education, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya- 224229.

Email: amritwarshini1312@gmail.com

Abstract

Food and nutrition security are fundamental pillars of human development, inextricably linked to gender identities and societal roles. Women in India often face limited access to productive resources like land, credit, and technology, hindering their agricultural productivity and income generation.

Women's voices are often marginalized in household and community decision-making processes related to food production, consumption, and resource allocation. Gender disparities in access to healthcare services and nutrition education can exacerbate women's vulnerability to malnutrition and related health complications. This paper delves into the complex interplay between gender, food access, dietary patterns, and nutritional well-being, with a specific focus on the Indian context. We argue that addressing food and nutrition security comprehensively necessitates understanding the gendered dimensions of food systems, encompassing production, distribution, consumption, and decision-making processes.

Through critical analysis of existing literature, policy frameworks, and case studies, we expose the double-edged plate faced by individuals based on their gender. While women play crucial roles in food production and household food management, they often experience higher burdens of food insecurity and malnutrition due to unequal access to resources, decision-making power, and healthcare services. Our findings underscore the urgency of integrating gender considerations into food and nutrition security policies and programs, paving the way for a more just and sustainable future where everyone has the right to a healthy and fulfilling life. Our analysis reveals the double-edged plate faced by individuals based on their gender, where they are both contributors to and victims of food and nutrition insecurity.

Addressing these disparities requires a multifaceted approach that Empowers women through education and skill development, promotes gender-responsive agricultural practices, Strengthens social safety nets and Integrates gender considerations into food and nutrition policies. By dismantling gender inequalities and promoting women's empowerment, we can pave the way for a more just and sustainable food system where everyone has the right to a healthy and fulfilling life. Only then can we truly break the double-edged plate and ensure food and nutrition security for all.

Keywords: Gender Equality, Food Insecurity, Malnutrition, Women Empowerment, Agricultural Productivity, Development Policies.

Effect of fortified soy food on height, weight and other parameters among school going children of rural Jharkhand in prevention of malnutrition

Dr. Bharti*

*Scientist, Krishi Vigyan Kendra, Lohardaga,
Birsa Agricultural University, Ranchi – 834006, Jharkhand.
Corresponding author: bhartibau@gmail.com

Abstract

Protein and energy malnutrition continues to be a global health problem particularly in developing and under developed countries. This is attributed to high levels of poverty where most households cannot afford animal source proteins. Cheaper and sustainable legumes can be used to address this. The term malnutrition means both under-nutrition and over-nutrition. It signifies the lack of balance in micro-nutrients in daily food intake.

In developing countries, under-nutrition ranks first and, together with micronutrient deficiencies like iron, zinc and vitamin A etc., contribute to over 24 percentage points of disease burden, as judged by the loss of disability-associated life years. Diet and nutrition have tremendous potential for improving health. Nutrition is the basic foundation for health and development.

Food fortification has been emerged as an effective and economically viable strategy to address the micronutrient deficiency for people living in impoverish socio-economic condition. In India, problem of micronutrient deficiency among poor children can be addressed by this strategy.

Present study was conducted on 120 children of age group 3 to 6 years of both the sexes. All children were divided in 4 groups i.e. 1 control and 3 experimental. This study was conducted to find a viable solution to the malnutrition problems affecting rural and marginalized people.

Keywords: Nutrition, Malnutrition, Fortification, Soy food, Micronutrient

Enhancing Maternal and Child Nutrition: A Holistic Approach through Nutrition Education in Tribal Communities

Padmaja Ravula and Kavitha Kasala
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Telangana, India

Abstract

Knowledge of mothers regarding nutrition has an important role in maternal and child nutritional outcomes. Focused on vulnerable tribal communities in Telangana, India, our research aimed to improve nutrition literacy through a comprehensive nutrition education intervention using a holistic method. Baseline surveys identified high levels of undernutrition and low dietary diversity among pregnant women, lactating mothers, and adolescent girls. For enhancing nutrition literacy, adopted three approaches: A. Applying a Knowledge-Attitudes-Practices (KAP) methodology, involving frontline staff and program beneficiaries, we introduced a refined scoring system, departing from the conventional equal-weight method to categorize the data. Our approach differentiated between direct responses (Type I) and multiple-choice answers (Type II), assigning nuanced weights based on existing literature The KAP analyzed data revealed the need for a tailored nutrition education strategy. B. A subsequent survey identified limited mobile phone access to carry out digital education especially among women, prompting on-site interventions. C. Nine nutrition education sessions covering diverse topics, including balanced diets, micronutrients (iron, folic acid, calcium, iodine, and Vitamin A), anemia, low birth weight, infant nutrition, food safety, and personal/environmental hygiene were conducted for each category of beneficiary. Statistical analysis of baseline and end line KAP surveys demonstrated improved knowledge levels on iron and Vitamin A (5% significance level). However, attitudes and practices remained unchanged. Notably, education on food safety led to significant knowledge improvement (10% significance level). In conclusion, this research provides scientific insights into developing sustainable nutrition education interventions to foster equitable and sustainable dietary practices within conventional agri-food systems.

Key words (5-6): Nutrition, Method, Knowledge, Attitudes, Practices, Vulnerable groups.

Assessing the Comprehensive effect of Factors impacting the Food and Nutritional security of Farm women

Ms. Khushboo Yadav[1], Dr. M. Preethi[2], Dr. R. Geetha Reddy[3] and Dr. K. Aparna[4]

[1]Ph.D. Research Scholar, [2]Professor, [3]Professor & University Head, Department of Extension and Communication Management, College of Community Science, PJTSAU, Saifabad, [4]Senior Scientist & Head, MFPI- Quality Control Laboratory, Extension Education Institute, PJTSAU, Rajendranagar, Hyderabad–500030

Abstract

Food and nutrition security are key underpinnings in the delicate fabric of global well-being, allowing communities to thrive. The Food and Agriculture Organization (FAO) defines food security as unfettered access to sufficient, secure, and nutritious food, supported by a supportive environment of sanitation, health services, and care that promotes an active and healthy lifestyle. This narrative takes on additional meaning when presented to the steadfast backbone of rural communities: agricultural women. An "Ex-post-facto" research design was used for the study. Choutuppal village of Yadadri Bhuvanagiri district of South Telangana state was randomly selected for the present study. Interview schedule was implied on the 30 randomly selected farm women. The data were drawn and further statistically analyzed.

Independent factors include age, education, family size, family type, landholding, yearly income, cropping pattern, and social involvement, identified through a literature evaluation. Yogesh's (2021) schedule assesses the dependent variable—the food and nutritional security status. Structured interviews with a tailored schedule serve as the primary data collection method. Results reveal significant correlations between age, education, landholding, annual income, cropping pattern, and social participation with food and nutritional security. This comprehensive research contributes to the understanding of the food and nutritional security situation of farm women in the Yadadri Bhuvanagiri district, offering a solid foundation for future analyses and policy interventions. The findings underscore the need for targeted measures to empower farm women, recognizing their pivotal role in ensuring a healthy and secure food future.

Keywords: Assessment; Diversity; Farm women; Food & Nutrition Security; Well-being

Gender Equality for National Food Security

Nikhil Kumar[1*], Dr. Sabita Mondal[2], Amrit Warshini[3], Neha Kumari[4]

[1*&4]Ph.D. Research Scholar, Department of Extension Education, Bihar Agricultural University, Sabour, Bhagalpur, Bihar-813210

[2]Assistant Professor, Department of Extension Education, Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar, West Benagal-736165

[3]Ph.D. Research Scholar, Department of Extension Education, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya-224229

Corresponding Email: - nikhilkumar.ext01@gmail.com

Abstract

Various available literature states that a big portion of food producers of the country are women and in -charge of feeding the entire family. However, women's own food security is at risk, owing to gender norms and gender inequality existing in the country creating significant risks for the families, communities, and nation as a whole.

Despite the fast-economic growth in India, many women and girls in the country, irrespective of their community, are in a state of food insecurity. This insecurity exists owing to diverse inequalities, such as restricted access to production and economic assets, education, job, decision-making etc. Persistent problems such as HIV/AIDS and Gender Base Violence (GBV) are also found among the daughters of our country. Moreover, COVID-19 pandemic had increased the burden of domestic work on women and restricted their opportunities on women equal rights, thus resulted a significant backward step in gender equality.

These inequalities will further vex the food crisis among the people. Review of various literatures advocates that the increasing women's economic participation and household decision making can be a strong solution to lessen the poverty and better the food and nutritional security. An increased qualitative and quantitative research, across the context, is thus needed, to display the impact and relation of gender equality and food security in the country.

Main recommendation is to give women the required space in research data collection methods and analysis to make the gap visible and work with them to find solutions that tight those gaps.

Key words- Food Security, Gender, Gender Equality, Nutritional Security

Bioactive compounds and antioxidant analysis of ten aquatic plants of Manipur

Okram Abemsana Devi*[1] and Mridula Saikia Barooah[2]

1. Lecturer, Dept. of Education (S), Manipur, Email*:okramabemsana@gmail.com
2. Professor, Dept. of Food Science & Nutrition, College of Community Science, AAU-Jorhat-13

Abstract

Aquatic plants are abundant in bioactive compounds as they can withstand harsh climatic conditions including high or low temperatures, pressure, acidic or alkaline water, and a limited amount of substrate in the water. The present study examines the correlation between bioactive compounds and the antioxidant activity of ten edible aquatic plants from Manipur. The antioxidant activity was assessed by the 1,1-diphenyl-2-picrylhydrazyl (DPPH) assay, the cupric-reducing antioxidant capacity (CUPRAC), and the ferric-reducing antioxidant power (FRAP) assay using a UV spectrophotometer.

Hierarchical cluster analysis using dendrograms was applied to evaluate the association between antioxidant properties and bioactive substances and to better understand the similarities and differences between them. The results showed that the antioxidant capacity ranged from 23.22±0.42 to 82.36±0.12 µM TEAC/g dried weight. In three assays, maximum antioxidant capacity is in the same order: *Jussiaea repens* > *Enhydra fluctuans* > *Zizania latifolia*, ranging from 58.07±0.05 to 82.36±0.12 µM TEAC/g dried weight. Pearson correlation confirmed that all three antioxidant assays were positively correlated, and phenolic content has contributed more to antioxidant activity than other bioactive compounds.

Hierarchical cluster analysis depicted a clear and distinct separation into two major clusters representing the ten varieties of aquatic plants. Among ten aquatic plants, *Jussiaea repens, Enhydra fluctuans,* and *Zizania latifolia* were identified as the most promising ones that could be utilized as a source of natural antioxidants and functional ingredients or nutritional supplements in dietary foods.

Keywords: Aquatic plants, antioxidant, bioactive compounds, Manipur

Gender Inclusive Transformative Approaches for Conservation Agriculture:

Strategies and Trade-offs

Pragati Shukla[1], S.L. Kameswari[2] & Dr. Shirisha Junuthula[3]

[1&2] Consultant & 3. MANAGE Fellow, National Institute of Agricultural Extension Management (MANAGE), Hyderabad.

Corresponding author Mail id: pragati.manage@gmail.com

Abstract

Challenges to future food and nutrition security arise from climate change, natural resource overexploitation, and widespread social inequalities. While many proposed solutions prioritize technology, they often neglect considerations of gender and social disparities. This paper delves into the intersection of gender, human development, and the opportunities and trade-offs associated with the advancement of technology in agricultural development.

Our focus is on conservation agriculture (CA), a component of cropping systems with nutrition- and climate-smart potential. Drawing from a literature review and case studies, we identify situations where the promotion of CA among smallholders in developing countries may unintentionally yield adverse effects from gender and human development perspectives.

These concerns include issues such as drudgery, nutrition and food security, residue use, assets, mechanization, and extension services. The extent and nature of potential trade-offs hinge on local contexts and specific interventions. Following the analysis, we explore opportunities and pathways to mitigate these trade-offs.

Strategies include gender transformative approaches, collaboration with non-traditional partners possessing diverse yet complementary perspectives and strengths, the strategic combination of technologies and approaches, and the formulation of inclusive development policies.

Keywords: trade-offs, conservation agriculture, gender transformative approaches.

Nutritional Security Dynamics: Investigation on Consumer Preferences and Priorities for Pork Consumption in Bengaluru

[1]Raghavendra, P. K. [2]Ganapathy, M. S. and [3]Siddayya

[1] Ph.D. Scholar, [2] Professor and University Head, [3] Professor and Head, Institute of Agri-business Management, University of Agricultural Sciences, Bangalore-65,

Corresponding author: raghavscholar65@gmail.com

Abstract

This study, conducted in Bengaluru, aimed to analyze consumer preferences for pork, utilizing a sample size of 120 respondents. Employing conjoint analysis, the research investigated key attributes influencing consumer choices, with a focus on understanding how these preferences contribute to nutritional security.

The study encompassed various attributes, including the type of pork (Farm Pork vs. Country Pork), price ranges (Up to Rs. 250 per kg, Rs. 250 per kg – Rs. 350 per kg, More than Rs. 350 per kg), purchase location (Shop vs. Directly from farm), and frequency of purchase (Weekly, Fortnightly, Monthly). By utilizing conjoint analysis, the study determined utility levels and the relative importance of each attribute, particularly in the context of promoting nutritional security through pork consumption.

The findings not only provide insights into factors significantly influencing consumer preferences for pork in Bengaluru but also offer valuable information for producers and marketers in the pork industry. This research contributes to a holistic understanding of how consumer choices in pork consumption can be aligned with nutritional security goals, guiding strategic initiatives for a more sustainable and health-conscious pork market in Bengaluru.

Keywords: Conjoint analysis, Consumer preference, Pork, Nutritional security

Application of Plant Growth-Promoting Rhizobacteria in Rice for Enhancing Nutritional Properties

Tribhuwan Singh[1*], S. C. Shankhdhar[1], Deepti Shankhdhar[1], Munmun Kothari[1]

[1] Department of Plant Physiology, GBPUAT Pantnagar

Abstract

Micronutrient deficiency, particularly in zinc (Zn) and iron (Fe), remains a pervasive global health challenge, with rice (Oryza sativa) being a staple food source for a significant portion of the world's population. Bio-fortification, the process of increasing the nutrient content of crops through agronomic practices, has emerged as a promising strategy to address this issue. This study investigates the potential of plant growth-promoting rhizo-bacteria (PGPR) to enhance Zn and Fe bio-fortification in rice grains. The experiment [kharif season 2022-23 and 2023-24] involved the application of selected PGPR strains to rice plants under field conditions. The rhizo-bacterial strains were chosen for their known ability to enhance nutrient uptake and promote plant growth.

The results demonstrated a significant increase in Zn and Fe concentrations in rice grains compared to control plants not treated with PGPR. The PGPR treated plants exhibited enhanced root development, altered photosynthetic rate, stomatal conductance, transpiration rate, intercellular CO_2 concentration (Ci), and improved nutrient solubilization in the rhizosphere. These findings suggest that PGPR plays a crucial role in facilitating the uptake and translocation of Zn and Fe within the rice plant, leading to elevated micronutrient levels in the edible grains. Furthermore, the study highlights the potential of harnessing PGPR as a sustainable and environmentally friendly approach to enhance the nutritional quality of rice crops.

Bio-fortification through PGPR-mediated mechanisms offers a viable solution to combat micronutrient deficiencies and improve food security, especially in regions where rice consumption is prevalent. As global efforts focus on addressing malnutrition and promoting sustainable agriculture, the integration of PGPR-based bio-fortification strategies into crop management practices holds great promise for enhancing the nutritional value of essential food crops like rice.

Keywords: Micronutrient, Bio-fortification, PGPRs, Rice

Effect of Dietary inclusion of Cashew nut kernel meal on Growth performance and Carcass traits in Ram lambs and Quails

K. Raja Kishore[1], B. Sravani[2] and C.S. Kathyayini[3]
[2&3]M.V.Sc Student, *Associate Professor and Head,
Sri Venkateswara Veterinary University, Department of Animal Nutrition
NTR College of Veterinary Science, Gannavaram-521 102, Andhra Pradesh
Email: dr_rajakishore@yahoo.co.in

Abstract

A study was conducted to evaluate the effect of dietary inclusion of Cashew Nut Kernel Meal (CNKM) on growth performance and carcass traits in ram lambs and quails. In the first experiment, 18 ram lambs were divided into 3 equal groups of six each and allotted to three dietary treatments (T_1 to T_3) comprising of green fodder *viz.*, Super Napier and concentrate mixture (20% CP) containing CNKM at 0, 10 and 20%, respectively. The body weight gain and average daily gain increased (P<0.05) from T1 to T3, while the feed cost per kg weight gain decreased by ₹ 1.46 in T2 and ₹ 19.81 in T3 as compared to control. Carcass studies had no effect (P>0.05) on various carcass parameters, proportion of whole sale cuts and yield of visceral organs among the different treatments. Hence, concluded that CNKM can be included up to 20 % in the concentrate mixture for economical meat production in ram lambs. In the second experiment, CNKM was included at 0 (T_1; Control), 5 (T_2), 10 (T_3), 15 (T_4) and 20 (T_5) per cent levels in iso-caloric and iso-nitrogenous broiler quail diets.

Data revealed higher body weight (P<0.01) and performance index (P<0.05) at 20% level (T_5) compared to other groups, while no effect (P>0.05) was observed on feed intake, feed conversion ratio and protein efficiency ratio among the different dietary groups. Carcass trait yields were statistically similar among the different treatment groups and the feed cost/kg gain decreased by ₹ 1.30 in T_2, ₹ 3.67 in T_3, ₹ 7.21 in T_4 and ₹ 11.5 in T_5 groups of quails compared to the control. It was concluded that CNKM can be included up to 20% in quail diet without any negative impact.

Key words: Carcass traits, Cashew nut kernel meal, Growth, Quails, Ram lambs

Access to Land Impacting Livelihood of Farm Women

Sabita Mishra, Anil Kumar, D. N. Sarangi and B. C. Behera
ICAR-Central Institute for Women in Agriculture, Bhubaneswar, Odisha
Corresponding Author: sabitamshra@rediffmail.com

Abstract
The strong Indian tradition, it's culture and patriarchal mind-set play an important role to restrict women for land ownership. Very less percentage of women secure land rights who take decisions for enhancing the productivity of their farms. According to World Bank (2019), insecure land rights create obstacles for women engaged in agriculture or allied activities or running a home-based enterprise. Further, Gender and Land Rights Database (GLRD) of the Food and Agriculture Organization (FAO, 2018) shows that the share of women agricultural land holders globally is less than 15%. Even in India, only about 14% of the women are operational holders (Agriculture Census, 2015–16). On the other hand, the 2030 Agenda for SDGs has also flagged the importance of providing women with equal and secure land rights (United Nations, 2017) in promoting sustainable development. A study made by FAO (2011) highlights that, "same access of women to Productive Resources as men can boost yield by 20-30%, Agricultural Productivity by 2.5-4% and lessen the number of hungry people in the world by 12-17%". Understanding the magnitude of women's access to land, ICAR-CIWA took initiatives for providing access to farm women towards homestead land for mushroom cultivation which is simple, viable, less labour intensive and profitable. Subsequently, the scientists of ICAR-CIWA identified 47 WSHGs in Nimapara block under Puri district of Odisha and created gender sensitization among farm families to get support from the men counterparts. The husbands also came forward and supported 47 women leaders by giving them homestead lands for 15 years on lease basis with a provision of Rs.500/- rent per year. Consequently, the leased land ownership impacted women to avail MSME loan Rs.6-8 lakh/ group for 3 years with 50% subsidy and Rs.0.5 lakh per woman for one year with no interest for mushroom cultivation. Currently, with developed leadership, the confidence level and communication skill of women was found to be enhanced. They are empowered enough to freely express their issues and demand for rights before the government officials. Majority of the groups grow 1200 straw mushroom beds in a month in the net house (75ft x 35ft) with three tier system. Accordingly, they earn Rs. 2.40 lakh within a month against an investment of Rs 0.87 lakh and profit of Rs1.53 lakh. Technologically they are competent to impart training to other women in the area as Master Trainers. The women members use smart phone and are skilled to take photographs for geo-tagging location, search google, register in Go Sugam Site (Odisha Krushak Portal), use email, transactions through phone pay, etc. Therefore, the study concludes that, the enhanced access of women towards land definitely develops gender sensitive social climate, access to information, women employment, women leadership, nutritional security and gender participation in decision-making.

Key words: Gender, Land rights, Access to Land, Impacting Livelihood, Farm Women

Theme 5: Policy and Economics of Sustainable Agriculture

Harvesting Wisdom: Unveiling Sustainable Food Systems through the Experiences of Agricultural Officers in Odisha

Shirisha Junuthula[1], Veenita Kumari2 and S.L. Kameswari3

[1]MANAGE Fellow, [2]Deputy Director (Gender Studies) & Head, [3]Consultant, Centre for Gender in Agriculture, Food and Nutritional Security, Urban Farming (CGANSUA), National Institute of Agricultural Extension Management (MANAGE) Rajendranagar, Hyderabad- 500 030, Telangana, India

Abstract

This study addresses the pressing global challenges of food security, sustainability, and the need for concerted efforts in the food system. The focus is on Sustainable Food Systems (SFS) and the urgent necessity to feed a growing global population while ensuring environmental sustainability. The introduction highlights the interconnected challenges faced by the global community, with a central concern being hunger and malnutrition, as outlined in the United Nations' Sustainable Development Goal 2 - Zero Hunger.

The research introduces a training program initiated by the Odisha State Government in collaboration with the National Institute of Agricultural Extension Management (MANAGE), aimed at addressing these challenges. The study presents objectives, including evaluating the perceptions and knowledge of Odisha's Agricultural Officers regarding global food security challenges and sustainable agriculture principles. The methodology involves participant selection through purposive sampling, with 49 Agriculture Officers from different districts in Odisha. Pre and post-assessment questionnaires are employed to gather information on participants' knowledge, attitudes, and perceptions related to sustainable food systems. Training sessions are conducted to enhance understanding, and post-assessment responses are collected to analyze changes in knowledge and attitudes.

The study's overarching themes encompass Sustainable Agriculture, Climate Change Adaptation, Disease Management, and Organic Farming & Agro-forestry. The findings emphasize policy implications such as incentivizing sustainable agricultural practices, addressing climate change impact, promoting disease management strategies, and supporting the transition to organic farming and agroforestry. In conclusion, the study underscores the urgency to reframe agricultural policies towards sustainability, climate resilience, and eco-friendly methodologies. It advocates for collaborative efforts involving governments, agricultural institutions, and local communities to achieve a holistic and sustainable transformation in agricultural practices, ensuring food security, environmental preservation, and the well-being of farming communities.

Key words: Agricultural Officers, Agricultural practices, Attitudes, Knowledge, Perceptions, and Sustainable food systems

Role of Custom Hiring Centers in Accessibility and Adoption of Improved Farm Machinery in Rayalseema Region of Andhra Pradesh

Ganavi N R[1], Dr. Nalini Ranjan Kumar [2], Ravikumar S [3]

[1&3] Research Scholar, Agricultural Economics,
University of Agricultural Sciences, Bengaluru.
2. Principal Scientist (Agricultural Economics.), ICAR- National Institute of Agricultural Economics and Policy Research (NIAP), Dev Prakash Shastri Marg, Pusa, New Delhi

Abstract

This study was conducted during the year 2020-21 to assess the present status of custom hiring Centers, accessibility and adoption of improved farm machinery through custom hiring centers established with government support, and constraints faced by groundnut growing farmers in the Anantapur District of Andhra Pradesh. Primary data for the study was collected from 160 farmers by personnel interview from Anantapur and Dharmavaram taluks of Anantapur district.

Tabular analysis, the Garrett ranking technique, and the Mechanization index were used to analyze the data. The Mechanization Index (MI) for Marginal farmers was lower compared to small farmers and overall MI for farmers of CHC villages was higher compared to farmers of non-CHC villages this was due to higher adoption and easy accessibility of farm machinery in the case of CHC farmers compared to non-CHC farmers.

Timely unavailability of custom hire services and their unavailability on a credit basis were the major problems faced by CHC farmers whereas higher rates, timely unavailability of services, discriminatory rates, etc. were the major problems of farmers in non-CHC villages. Hence there is a need to improve access to farm machinery for small and marginal farmers by establishing more CHCs and providing a sufficient number of implements to CHCs to improve the availability of services on time.

Keywords: Custom Hiring Centers, Mechanization Index, Garrett Ranking Technique, CHC villages, Non-CHC villages

Performance comparison of Machine learning technique for forecasting of Green gram prices in Andhra Pradesh

P. Swarnalatha[1], A. Yaminileela[2], V. Srinivasa Rao[3]

[1] Ph. D (Ag.), Research Scholar, [3]Associate Dean, Professor & Univ. Head, Department of Statistics and Computer Applications, Agricultural College, Bapatla.

Corresponding author- swarnalathapotluri@gmail.com

[2] Ph. D (Ag.), Research Scholar Department of Agricultural Extension Education, Agricultural College, Bapatla.

Abstract

Green gram is one of a crucial pulse crop in India. It is the third important pulse crop in the country, which occupies nearly 16 per cent of the total pulse area in India. It contains protein-rich seeds with 20-25 per cent protein. It was cultivated as a short-duration legume crop and also grown as a fallow crop in rotation with rice, it enhances soil nitrogen levels. India accounts for over 70 per cent of the global green gram production, plays a dominant role in its cultivation worldwide. In India during the year 2022-23 Green gram production was 1.75 million tones with acreage of 0.61 lakh acres with productivity of 248 kg per acre.

In Andhra Pradesh, Green gram was cultivated in an area of 0.97 lakh ha with a production of 0.83 lakh tones, contributing 4.74 per cent of production to country. Green gram prices were ruling in the range of Rs. 7000 to Rs. 9,200 per quintal against the minimum support price of Rs. 7,755 a quintal. The present study employed to compare the forecasting performance of different models ARIMA, ANN, SVR and RF models on the monthly prices of Green gram in Andhra Pradesh based on data from January 1991 to October 2023. Diebold-Mariano test was performed to test for the significant differences in prediction accuracy of different models.

The study concluded that among all the models, ANN and SVR models were performed better than other two models. Among ANN and SVR the ANN model performed in forecasting the Green gram prices with least RMSE (205.89), MAE (136.26) and MAPE (5.85) values and SVR model with RMSE (210.89), MAE (128.35) and MAPE (5.95) values. With the ANN model made forecast from November 2023 to October 2024 and the prices will be ranges from Rs.8,800 to 9,500 a quintal.

Keywords: ARIMA, ANN, forecasting, Price, RF, SVR.

A Study on e-NAM and its Implication for Farm Income: A Case Study in Suryapet District of Telangana

Ravikumar S [1], Dr. Venkatesh P[2], Ganavi N R [3]

[1&3] Ph. D. Agricultural Economics, University of Agricultural Sciences, Bengaluru, ravikumarskannadiga@gmail.com , [2] Principal Scientist , Division of Agricultural Economics, ICAR-Indian Agricultural, Research Institute, Pusa Campus, New Delhi.-110012, India, venkatesh1998@gmail.com,

Abstract

This study was conducted in the year 2020-21 to assess the status of commodities traded through e-NAM and to identify the major marketing channels for paddy, along with analysing the price realization by farmers through different marketing channels in Suryapet district of Telangana state. Primary data for the study were collected from 240 farmers through personal interviews in Suryapet district, while secondary data were obtained from the e-NAM website and the district collector's office.

Tabular analysis and propensity score matching techniques were employed for data analysis. The results shows that quantity traded through e-NAM highlights oilseeds and fibre crops with significant shares in both quantity and value traded to total production. Groundnut and turmeric dominate the percentage of quantity traded, while maize holds a major share in percentage value of trade. Ragi and tamarind stand out as extensively traded commodities due to their ease of transportation over long distances. The decentralized paddy procurement program, IKP, emerges as a prominent marketing channel, providing direct benefits to farmers in their villages. Comparisons between e-NAM and IKP farmers reveal minimal differences in paddy cultivation costs, except for transportation. Interestingly, farmers participating in e-NAM realize lower prices compared to non-participants.

The study concludes that e-NAM participants in Suryapet district of Telangana do not secure better paddy prices due to market dynamics, unlike IKP, which ensures MSP rates. Consequently, there's a pressing need to enhance e-NAM performance by aligning prices with MSP rates for comprehensive farmer benefits. Recognizing the profitability of IKPs, improving e-NAM efficiency is crucial for securing better paddy prices. Thus, targeted measures should be implemented to enhance the functionality of e-NAMs.

Keywords: e-NAM, IKP, MSP, Profitability, Efficiency

Urban farming through Student READY in ICAR-SAU System for comprehensive food security

V. Rajendra Prasad[1], V. Chandra Sekhar[2], D. Uma Maheswara Rao[3], R.Saritha[4], Ch. Mukunda Rao[5], K.V. Ramana Murthy[6] and P.V.K. Jagannadha Rao[7]

[1.] Senior Scientist & Head, Department of Agricultural Economics, [2.] Senior Scientist, Department of Plant Pathology, [3.] Extension Specialist, Department of Agril. Extension, [4.] Principal Scientist, Department of Entomology, [5.] Principal Scientist (Plant Physiology), [6.] Principal scientist (Agronomy) and [7.] Associate Director of Research of Regional Agricultural Research Station, Anakapalle-531001, Acharya N.G. Ranga Agricultural University (ANGRAU).

Abstract

The overall urban development strategy of India needs a paradigm shift to sustainable and ecological urbanization. In this context, it is high time for the ICAR and SAU to make inroads into urban farming to offset the productivity pressures on rural areas, for enhancing food and nutritional security. So far our direct foot print is in rural areas only.

The RAWEP and ELP semesters in the UG could have an additional option to reside in urban areas also. Urban farming could be introduced in any of the five components i.e. Experiential Learning, Awareness Works Experience, In-Plant Training / Industrial attachment, Hands-on training (HOT)/Skill development training and Students Projects that were prescribed for Student READY program by ICAR. Aquaponics, Rooftop Urban Farm, Growing specialty crops for high end restaurants, Micro greens, edible flowers, and mushrooms can be some of the activities that can be undertaken by final year undergraduate students.

The modus operandi/ methodology might include exploring more underutilized spaces such as below highway viaducts, creating care farms for people with special needs, social enterprise Farms, micro farms in obscure spaces, growing herbs and vegetables in offices as staff engagement & CSR, Community gardens and community composting and running a certificate course in urban agriculture.

Keywords: Urban farming, Urban food security, Nutritional security, Community gardens, Experiential learning.

Trends analysis in Production, Consumption and Trade of Major Sudanese Cereals Commodities over the Last three decades

Elgilany A. Ahmed (PhD) and Fatima Rahma Mohammed
Agricultural Research Corporation (ARC), Sudan, Central Ministries of Agriculture and Forests
*E-mail: elgilanya@yahoo.com,

Abstract

The paper analyzes the major Sudanese commodities by examining trends in cereals, consumption and trade for a 10-years period (term) for the last three decades (1990 to 2021), and indicates the projections for production, consumption and demand up to 2030. The paper depended on secondary data collected mainly from annual statistics of the central Ministries of Agriculture and Forests for various years.

The findings have shown that the production of cereals crops namely, sorghum and millet shows highest annual growth rates respectively during the first and the third terms in the rain-fed sector, while wheat shows a high annual growth rate during the second and the third terms. It is clear that, total cereals consumption in the Sudan rose at an average annual rate higher than the production rate for the whole period of study. To meet the shortfall between wheat consumption and production, the crop and its flour imports increased. This has exerted a heavy burden on the country's development and create a negative trade balance due to deteriorating foreign exchange resources. Therefore, the expected improvement in wheat production needs to maximize the available domestic resources by using modern technologies rather than the expansion of cultivation areas, this will minimize the gap between potential yield and producer' yields. Sorghum is mainly grown for local consumption by small scale holders (60% of quantity produced) in main producing areas, particularly in traditional rain-fed farming, in semi-mechanized and in irrigated agriculture. The period 2000 – 2010 was the period of oil export from Sudan which was the major source of foreign currency to the government neglecting traditional agricultural exports and the impact was a deterioration on agricultural export quantities leading to declining total values from all agricultural exports due to negligence of development of the sector impacting deterioration of existing infrastructure.

Keywords: cereals, commodities, trend, analysis, Sudan

Sustainable Agriculture Economics: A Comparative Cost Analysis of Conventional and Natural Farming Methods in Andhra Pradesh Community-Managed Natural Farming

Adupa Shanmuka [1], N.V. Kumbhare [2] and T.N.S.S. Srivani [3]

[1.] Scientist, [3.] Research Scholar, ICAR-Directorate of Groundnut Research, Junagadh

2. Principal Scientist (Ag. Extn), ICAR-Indian Agricultural Research Institute, New Delhi

n_kumbhare@yahoo.com

Abstract

Andhra Pradesh is leading in natural farming due to the presence of an initiative named Andhra Pradesh Community Managed Natural Farming (APCNF) in all the districts by a not-for-profit organization named Rythu Sadhikara Samstha under the guidance of Andhra Pradesh state government. A study was taken up in the district of Guntur with focused group discussions with the farmers who have been adopting the natural farming (NF) practices of APCNF for more than 5 years. The study aimed to compare the cost of cultivation and benefit-cost ratio of the farmers following Natural farming with and without cattle, with those of conventional farming in Paddy. The principle of NF promotes the use of indigenous seed only which is a replacement to the cost incurred for seed purchasing. NF is known for its low-cost efficiency as the natural inputs are homemade and require a very low cost of preparation as all the raw materials are cattle-derived or easily available to the farmer who has livestock on his farm. Farmers without livestock depend on goshalas for the raw material which is comparatively cheaper than conventional farming inputs. Thus, the input material cost is the primary factor for the cost efficiency. In NF, as none of the inputs is available readymade it includes the preparation of bio-stimulants with long procedures that require a large amount of time and labor which accounts for the major cost in cultivation. Spraying of herbicides is also prohibited in NF because of which weeding accounts for a major increase in the cost of cultivation. The yield analysis in many research studies states that comparatively NF yields less than conventional chemical-intensive farming in the initial years. When the cost-to-benefit ratio is analyzed, conventional farming has higher revenue but profits are lower compared to NF due to lower input costs. Considering the comparative economic analysis, NF is at the positive in the cost-efficiency ratio and benefit-cost ratio compared to conventional farming including input costs, labor requirements, and overall operational expenses despite its low yield.

Key Words: APCNF, Cost of cultivation, Natural Farming, Conventional Farming, Benefit Cost ratio, Paddy

Impact of Krishi Bhagya Scheme on Beneficiary farmers of Karnataka state

Chaithra N.R.[1], Basavaraj Beerannavar [2], Prashant [3].

[1]Research Scholar, Department of Agricultural Extension, UAS, GKVK, Bengaluru, [2] Professor, Department of Agricultural Extension, KSNUAHS, College of Agriculture, Shivamogga, [3] Research Scholar, Department of Agricultural Extension, Indian Agricultural Research Institute, New Delhi

Abstract

India being an agrarian country, the total grain production of our country is 285.21 million tons in 2020, but it has to reach nearly 370 million tons by 2050. But the major challenge is to stash away the runoff water for agricultural crops during the dry spell. With this insight, the government of Karnataka has started flagship program, namely "Krishi Bhagya Scheme" a pivotal step towards achieving sustainability of rain-fed agriculture. The scheme had been extended to Malnad areas including Shivamogga district.

The study was conducted in Karnataka state with the sample size of 120 farmers consisting of 60 beneficiaries and 60 non-beneficiaries from Shivamogga district. The predominant findings of the study revealed that change in cropping intensity by 47 per cent, majorityof the beneficiaries (53.33%) had a medium knowledge, nearly 41.66 per cent have cultivated four to six crops that is moderate cropping pattern, 51.67 per cent of beneficiaries had high crop. This remarkable increase in the yield due to the reasons that availability of the farm pond water during the critical stages of the crops, which impacted on the crop to reach better yield potential.

The anecdotal evidence from this research will suggest policy makers a slew of appropriate strategies and interventions can be extended to other parts of the country to improve farmers income and leading to sustainable water usage.

Key words: Krishi Bhagya Scheme, Impact, Income.

Convergence of Extension Service Providers for Sustainable Agriculture Development

Parashuram Kambale[*1], Vikas Chowhan [2], Rakesh Bhatthad[3] and, S.B. Goudappa[4]

[1,2 &3] Ph.D. Scholar, Dept. of Agricultural Extension Education, University of Agricultural Sciences, Raichur -584104, Karnataka, India, [4] Director of Extension, University of Agricultural Sciences, Raichur -584104, Karnataka, India

Corresponding author: parashuramk2020@gmail.com

Abstract

A necessary condition for sustainable agriculture is that large numbers of farming households must be motivated to use coordinated resource management. It aims to meet the food and fiber needs of the present without compromising the ability of future generations to meet their own needs. It's about balancing productivity, environmental health, and economic viability. In this crucial mission, agricultural extension services are essential for helping farmers make the switch to sustainable farming methods.

Extension can contribute to a safe and fruitful future for agriculture by offering information, expertise, and assistance. A more integrated approach to extension services is being pushed by the increasing demand for sustainable agricultural practices. Historically, a patchwork of governmental organizations, non-profits, for-profit businesses, and academic institutions have offered these services, which has frequently resulted in incomplete or conflicting information, redundant work, and a narrow scope. But a potentially useful approach that attempts to unite these disparate actors for more impact is convergence.

The convergence will benefit in improved outreach and access, enhanced effectiveness and increased efficiency of extension service providers and ultimately the empowerment of farmers. The paper is about the present scenario of sustainable agriculture development and convergence of different extension service providers to deliver a holistic and farmer-centric approach to sustainable agriculture: challenges and future prospects.

Key Words: Extension, Convergence, Sustainable, Agriculture and Development

Government Policies and their Impact on Sustainable Agriculture

Sneh J. Devra[1], Siddharajsinh R. Raj[2], Mayur S. Shitap[3], Jaykumar B. Gajera[4] and Divya Agarwal[5]

[1, 2 & 5] Research Scholar, [3.] Assistant Professor, Department of Agricultural Statistics, JAU, Junagadh, Gujarat, [4.] Ph.D. Scholar, Department of Agronomy, JAU, Junagadh, Gujarat

Corresponding author: snehdevra21@gmail.com

Abstract

A paradigm shift in agricultural operations is required to meet the increasing demand for balancing environmental sustainability with food security. As a ray of hope, sustainable agriculture promises both ecological harmony and food production.

This paper explores the complex web of laws and regulations that influence the uptake and consequences of sustainable agriculture. We examine the kinds of policies that are being used, evaluate how well they work to encourage sustainable habits, and examine the range of effects they have on different stakeholders.

We highlight the advantages and disadvantages of various policy approaches by combining empirical data and case studies, and we conclude by arguing in favor of a complex and multifaceted strategy that promotes social justice, economic viability, and environmental stewardship in the agriculture industry.

Keywords: Sustainable Agriculture, Policies, Economics

Fortifying Food Systems: Policy Pathways for Nutritional Resilience

Y Sravani[1], B Swarnalata[2] and S Rahul[3]

[1] Ph.D. Scholar, Department of Vegetable Science, [2.] Ph.D. Scholar, Department of Entomology, Dr. Y.S.R Horticultural University, Andhra Pradesh, India. [3.] Village Agriculture Assistant, Department of Agriculture, Government of Andhra Pradesh, Andhra Pradesh, India.

Corresponding author: sravaniyerra17@gmail.com

Abstract

Global well-being depends critically on food and nutritional security, which are closely related to sustainable agriculture methods. The globe is facing several difficulties, including resource scarcity, population expansion, and climate change. In order to maintain a thriving agricultural ecosystem that provides enough nourishment for everyone, strong regulations must be created. These policies cover a wide range of strategies designed to improve food systems sustainability, availability to wholesome food, and agricultural output.

First, investigating the policies that support crop diversification, integrated pest control, and agroecology will increase food production while fostering resilience, biodiversity, and environmental sustainability. Furthermore, by encouraging the creation of resilient crop varieties, the adoption of efficient agricultural practices, and technological improvements, policies pertaining to research and innovation could ensure higher productivity while reducing environmental damage. Policies aiming at enhancing food accessibility are also necessary.

Proposals have been made to guarantee that vulnerable groups have access to nutritious food through initiatives that center on equitable distribution, local food markets, transportation infrastructure enhancements, and food waste reduction. Another main focus is on supporting smallholder farmers, highlighting the importance of policies that give them access to markets, loans, and agricultural training.

In conclusion, this abstract advocates for comprehensive policy frameworks that integrate sustainable agricultural practices, innovation, equitable food accessibility, smallholder farmer support, and climate resilience. In order to guarantee the effectiveness and inclusiveness of these policies and to imagine a day when food and nutritional security are widely attainable within agricultural ecosystems, stakeholders must work together.

Key Words: Agro-ecology, Technology, Resilience, Biodiversity and Stakeholders

Organic Trade for Development (OT4D)

Arya R. Chandran[1] and Reshmi R. Prasad[2]

[1] Research Scholar in Management Studies, Loyola College of Social Sciences, Sreekariyam, University of Kerala, Thiruvananthapuram, [2] Principal, All Saints' College, Thiruvananthapuram

Corresponding author: its2aryachandran@gmail.com

Abstract

Organic products are grown under a system of agriculture without the use of chemical fertilizers and pesticides with an environmentally and socially responsible approach. India is bestowed with lot of potential to produce all varieties of organic products due to its various agro climatic conditions.

In several parts of the country, the inherited tradition of organic farming is an added advantage. This holds promise for the organic producers to tap the market which is growing steadily in the domestic and export sector. One visible aspect of the efforts to make the agriculture sector more sustainable is the rise of organic agriculture. A dedicated drive by the central government and states to promote organic farming has led to a relative increase in organic agricultural land throughout the country.

As on 31st March, 2023 total area under organic certification process (registered under National Program for Organic Production) is 10.17 mha (2022-23). This includes 5391792.97 ha cultivable area and another 4780130.56 ha for wild harvest collection. NPOP has provided promising opportunities to organic stakeholders to meet the global market demand. The total volume of export during 2022-23 was 312800.51 MT. The organic food export realization was around INR 5525.18 Crore (708.33 million USD). A total of 6.12 lakh hectares of land and 9.32 lakh farmers were covered under PGS-India certification and 9.12 lakh hectares land and around 15 lakh farmers were covered under NPOP certification.

The future of organic products export from India holds promising prospects, driven by growing global demand for sustainable and ethically sourced products. Emerging trends include innovative packaging, niche product exploration, and technological advancements in supply chain management.

Key words: Organic agriculture, Organic products, Export, Sustainable agriculture, NPOP

Sustainable Agricultural Economics: Energy consumption pattern of cotton in Telangana State

S. Haripriya[1], Dr. B. Nirmala[2], Madhu, D M.[3]

[1]Ph.D Scholar, Department of Agricultural Economics, PJTSAU, Rajendranagar, Hyderabad, [2]Senior scientist, Department of Agricultural Economics, Indian Institute of Rice Research, Rajendranagar, Hyderabad, [3]Ph.D Scholar, Department of Agricultural Economics, University of Agricultural Sciences, GKVK, Bengaluru.

Abstract

Cotton is the world's oldest commercial crop and one of the most important fiber crops in the global textile industry, more than 100 countries worldwide depend on cotton for their income. In Telangana one of the most important is fiber and commercial crops. The sample farms were selected through a simple random sampling method.

The results revealed that cotton production consumed a total of 7738.52MJacre-1 of which fertilizer energy consumption was (77%) highest followed by Diesel and petrol energy at 9%, human energy at 6%, and chemical energy at 4 %. The total direct energy was 1142.60MJ acre-1, and 6750.57 acre-1 indirect energy. Renewable energy accounts for 519.55 MJ acre-1 and non–renewable energy was 7429.69 acre-1 which was high among other types of energy.

The impacts of indirect and non-renewable energy on cotton yield were higher than those of direct and renewable energy. Among the total variable cost, total human labour cost was high with Rs. 10810.5/-, followed by land preparation Rs.5540/-, and Total chemical cost of 4526.50/- respectively.

The value of energy use efficiency indicated that the energy output of cotton production is 1.02 times higher than that of total energy input, which implies that cotton production is an energy–efficient crop in the studied region.

Keywords: Cotton, direct energy, indirect energy, Renewable energy, and non-renewable.

Sustainability of Auction System Value Chains in Palakkad, Kerala - A Comprehensive Socio-Economic Inquiry

Nikhil K. S.[1] & Aparna Radhakrishnan[2]

[1] Project Fellow, [2] Assistant Professor, Agricultural Extension Education,
Krishi Vigyan Kendra, Thrissur, Kerala Agricultural University
Corresponding author: nikhilks7428@gmail.com

Abstract

In Kerala, the cultivation of bananas is facing a decline in both area and productivity, primarily attributed to diminishing soil fertility coupled with increased susceptibility to pests and diseases. To address this issue and uplift the farming community and related stakeholders, recent research endeavours have focused on enhancing the value chain sector. This study specifically delves into the sustainability of banana value chains in the Palakkad district, encompassing the Agali, Kumaramputhur, and Karimpuzha panchayaths.

The investigation comprehensively analysed economic, social, environmental, and technical factors to assess sustainability. Through a methodology involving key informant interviews and focus group discussions, information was gathered from key actors in the value chain. The study employed a weighted index approach to quantify the sustainability of various indicators. The findings highlight that the auction system value chain emerged as the most sustainable compared to alternative value chains. Actors within the auction system demonstrated high proficiency in economic variables, displayed progressive societal and environmental practices, and exhibited technical prowess. Notably, the VFPCK market, along with its auction system, facilitated an environment where banana growers and associated vendors could interact, ensuring equitable earnings for raw bananas.

The study suggests that by optimizing market support mechanisms and processing facilities, banana cultivation is poised to experience revitalization in key areas. Furthermore, the success of this framework implies its potential as a model for generating and implementing sustainable practices, calling for strategic policy interventions to promote sustainability across diverse fields of agriculture.

Keywords: Banana value chain, market, information sharing, financial earnings, sustainability

NARI Suwarna sheep farming as a livelihood support to farmers in Karnataka – An economic analysis

***Rahul Mooganur[1] and B. R. Jamakhandi[2]**,

[1]Student, [2]Assistant Professor, Department of Agricultural Economics, University of Agricultural Sciences, Dharwad.

Abstract

In India, agriculture is a significant occupation and source of revenue that supports the livelihoods of more than 58 per cent of the population. Indian agriculture has been expanding for a long time, supported by various allied activities like sheep, goat, cattle and poultry farming etc. Sheep rearing is one of the key sources of income and employment for rural residents.

NARI Suwarna is new breed of sheep developed from the NARI institute located in Phaltan, Maharastra which is capable of producing twin lambs. An economic analysis of NARI Suwarna sheep was analysed in the present study. For the study, the primary data was collected from 60 NARI Suwarna sheep farmers through snowball sampling technique across the Karnataka. The data was analysed by using the cost concepts. The total establishment cost for small, medium and large sheep farm was found to be Rs.3, 03,516, Rs. 6, 19,784 and Rs. 9,57,973 respectively.

The overall feed and fodder cost was estimated to be Rs. 3,06,243 and the overall labor cost was estimated to be Rs. 54,183 and the total cost for small, medium and large sheep farm, was found to be Rs. 2,52,584, 4,77,190 and 7,41,466 respectively. The total net returns obtained was Rs. 1,50,954, 3,79,808 and 6,65,026 in case of small, medium and large sheep farms respectively.

The net returns per NARI Suwarna sheep in small (1-25 sheep), medium (26-50 sheep) and large sheep (>50 sheep) farm was estimated to be around Rs. 10,063, Rs.11,869 and Rs.12,315 per year respectively.

Key words: Livestock census, NARI Suwarna sheep, snowball sampling, feed and fodder.

Theme 6: Socio-Economic Impacts of Sustainable Agriculture

Key note speaker for Theme 6

Sustainable Intensification of Agri-Food Systems in the South: Why Inclusion Matters

Vijesh V. Krishna
International Maize and Wheat Improvement Center (CIMMYT), Hyderabad

Abstract

This paper examines the transformative potential of Sustainable Intensification (SI) in agri-food systems, especially in developing economies where agriculture is pivotal for livelihoods, food security, and national income. Emphasizing the dual objective of securing food security while ensuring system resilience, the paper explores the indispensable role of innovative, effective, and inclusive SI practices and dissemination approaches. It contrasts conventional intensification methods with their more sustainable counterparts, underscoring the latter's commitment not only to enhancing productivity and curtailing environmental degradation but also to ensuring that these benefits are inclusively extended to all, including the marginalized communities of the Global South. The paper presents two case studies from India, which focus on the dissemination and impacts of SI technologies on marginalized sections of rural society – laborers and women farmers. The findings recommend R&D policies that balance productivity, environmental stewardship, and social equity, ensuring that SI benefits are equitably distributed across all societal segments.

1. Introduction

Agri-food systems play a critical role in developing economies, providing employment, ensuring food security, and alleviating poverty, and contributing to a substantial portion of the national income in the Global South. For instance, in Africa, agriculture contributes 35% of the Gross Domestic Product (GDP) and employs about half of its people (Signé and Munyati 2023). In India, the GDP share of agriculture is 20%, with 45% of the workforce dependent on it (Sharma 2023). Several researchers have pointed out the crucial role of agri-food systems in rural development. Investments in agriculture are considered to be at least three times better at reducing $1-day headcount poverty in low-income and resource-rich countries (Christiaensen et al. 2011). Empirical studies further point out that growth in the agricultural sector can be highly effective in reducing poverty (Ivanic and Martin 2018). As most of the food insecure and malnourished population reside in this region, enhancing agricultural productivity is crucial for ensuring food availability and affordability.

The capacity of the agriculture sector to develop rurality and alleviate poverty is heavily compromised by climate change, with increased risks of droughts, floods, high temperatures and changing weather patterns affecting crop yields and livestock productivity (Hertel and Rosch 2010; Molotoks et al. 2021). The associated ill effects of climate change, such as land degradation, water scarcity, and loss of biodiversity, further challenge the sustainability of agri-food systems in these regions. The adaptation ability of the agri-food systems, which provides resilience against unforeseen risks posed by climate change in a region, gains prime importance against this backdrop. Increased R&D

investment in agriculture, along with supportive policies and infrastructure development, can catalyze the transformation of agri-food systems, making them more sustainable and capable of contributing to poverty alleviation (Jones-Garcia and Krishna 2021; Alwang et al. 2019).

The present paper, using evidence from the existing literature, shows the characteristics and impacts of sustainable intensification (SI) and claims that SI practices can result in poverty alleviation when the technologies and practices are targeted to reach the poorer and marginalized sections of society. Furthermore, I present two case studies from CIMMYT research projects on the dissemination and impacts of technologies in eastern India to examine the conditions under which these technologies can lead to inclusive development.

2. Intensification vs. Sustainable Intensification

In its traditional sense, the intensification in agriculture focuses on maximizing agricultural output to meet the growing food demand. The practices associated with intensification include monoculture, extensive use of chemical inputs, and land expansion (Pimentel et al. 2004; Gibbs et al. 2010). While these practices have been successful in increasing food production, they have often led to adverse environmental effects, including soil degradation, water scarcity, loss of biodiversity, and increased greenhouse gas emissions (Tilman et al. 2002). SI is an umbrella concept developed as an alternative, which seeks to increase agricultural productivity while avoiding or minimizing negative environmental impacts. In other words, the goal is not just to increase food production but to enhance the ability of the entire agri-food system for sustained production (Garnett et al. 2013). SI involves the adoption of innovative farming techniques and practices that are resource-efficient, environmentally friendly, and socially inclusive, like integrated pest management, conservation agriculture, agroforestry, and the use of precision farming technologies. The expected outcomes of SI are increased agricultural productivity, improved soil health, enhanced biodiversity, better water management, and reduced carbon footprint (Tscharntke et al. 2012). Ideally, SI shall try to achieve these outcomes while ensuring equity and social inclusiveness, addressing the needs of smallholder farmers and marginalized communities. However, the effects of SI practices on social inclusion and equity are often left unexamined.

3. The Diverse Impacts of Sustainable Intensification

By redefining the paradigms of traditional farming, SI seeks to balance the necessity for increased agricultural productivity with the imperative of environmental stewardship. Its impact is far-reaching, extending beyond the tangible metrics of yield and resource efficiency to encompass broader societal and ecological benefits. This multifaceted strategy endeavors not only to bolster food production to satisfy the escalating global demand but also to foster an agricultural landscape that is efficient, environmentally benign, climate-resilient, and socially equitable. Here we explore the various impacts of SI.

- *(Land) Productivity:* It is the criterion of paramount importance while evaluating agricultural technologies. SI aims to increase the productivity of agricultural systems, ensuring sufficient food

production to meet the growing global demand. This involves improving yield per unit area without exerting additional pressure on natural resources.

- Techniques such as precision agriculture, improved crop varieties, and integrated nutrient management help in achieving higher yields while minimizing waste and reducing the need for chemical inputs (Jain et al. 2020; Kotu et al. 2017). While productivity can also be defined based on other factors of production (e.g., labor), land or area under cultivation is the widely used denominator.
- *Efficiency:* SI focuses on the efficient use of resources such as water, land, and inputs like fertilizers and pesticides. Practices like zero tillage, drip irrigation, and rainwater harvesting optimize the use of resources and reduce costs (Krishna and Veettil 2014). SI also promotes the use of renewable energy sources and energy-efficient technologies, thereby reducing the carbon footprint of agricultural practices (Kuyah et al. 2021).
    - *Environmental Benefits:* SI practices like crop rotation, cover cropping, and reduced tillage improve soil structure, enhance nutrient cycling, and increase soil organic matter, leading to improved soil health and fertility (Jat et al. 2021). Techniques such as efficient irrigation systems and water management practices help conserve water and reduce the impact of agriculture on water bodies. By integrating natural elements into farming systems (e.g., agroforestry, buffer strips), SI promotes biodiversity and supports the ecosystem services essential for agriculture (Pantera et al. 2021).
    - *Climate Resilience*: SI enhances the resilience of agricultural systems to climate change by improving the adaptive capacity of crops and farming practices (Adhikari et al. 2018).
    - *Poverty and Livelihood*: Compared to productivity and efficiency, the poverty and livelihood effects of SI are less documented in the literature (Krishna et al. 2020). The few existing studies that link them to technology adoption can be criticized for not adequately establishing the causal relationship. Unlike productivity and efficiency, which can be measured using quantitative metrics like yield per hectare or input-output ratios, assessing the impacts on poverty and livelihoods involves a more complex set of indicators. Furthermore, the impacts on poverty and livelihoods may take longer to materialize and be visible. This time lag can make it challenging to establish a clear causal relationship between SI practices and improvements in poverty and livelihoods. Possibly due to the insignificant or mixed effects of SI on poverty or livelihoods status, it may not get reported. Such publication bias – a well-known phenomenon in academic research, where studies with significant or positive results are more likely to be published than those with insignificant or negative results (Song et al. 2013) – could potentially contribute to a lack of documentation or evidence regarding the impact of SI on poverty and livelihoods, especially if studies fail to demonstrate clear, positive outcomes.
    - *Social Inclusion and Equity*: These aspects of SI-based interventions are rarely documented in the literature. Some studies (Dawson et al. 2019), demonstrate that while market-oriented intensification can drive poverty reduction, it simultaneously exacerbates marginalization and

poverty among vulnerable groups. The extent and nature of this intensified inequality vary, deeply influenced by the contextual factors that shape social disparities.

4. Impact Heterogeneity and Technology-Induced Marginalization

Impact heterogeneity refers to the varied effects that interventions, policies, or practices can have across different individuals or clusters (Plewis 2002). In the context of SI in agriculture, impact heterogeneity highlights how the benefits and drawbacks of agricultural practices are not uniformly distributed but vary significantly among different socioeconomic groups. Understanding and addressing this heterogeneity is crucial for ensuring that SI initiatives are equitable and beneficial for all stakeholders involved. Below, I discuss the concept of impact heterogeneity, emphasizing its manifestation in different socioeconomic contexts. The dimensions (hence, the implications) of impact heterogeneity can vary across interventions.

Impact heterogeneities due to varied experience by the recipients:

- The impact of farming technologies can vary greatly depending on the economic status of the farmers (Barrett et al. 2001). Wealthier farmers might have better access to resources, capital, and markets, allowing them to adopt and benefit from SI practices more readily than their less affluent counterparts.
- The size of the farm can influence the impact of SI. Smallholder farmers might face more significant challenges in terms of economies of scale, access to information, credit, and market.
- In contrast, larger farms might be in a better position to invest in advanced technologies and practices. Also, possession of the ownership deed of the land (e.g., land titles) could generate significant impact heterogeneity (Krishna et al. 2017).
- The effects of SI can also be heterogeneous based on geographic factors. Farmers in regions with favourable climate and soil conditions might experience more positive impacts compared to those in marginal areas prone to droughts, floods, or poor soil fertility (Kumar and Khanna 2023).
- Gender is a significant factor resulting in impact heterogeneity. Women farmers, who often face constraints in accessing resources, land, and information, might not benefit from SI to the same extent as men, unless specific gender-sensitive approaches are implemented (Paudel et al. 2020).
- Age and Education: Younger, more educated farmers might be more receptive to innovation, while older farmers may rely on traditional methods and be resistant to change (Paltasingh and Goyari 2018).
- Cultural and social norms can affect the adoption and impact of SI practices (Tran-Nam and Tiet 2022). For example, certain communities might be more open to cooperative farming practices, while others might prefer individual land ownership and management.

Impact heterogeneities due to project implementation:

- Some of the R&D interventions are inherently complex and multifaceted, often leading to impact heterogeneities (Plewis 2002). Social and agricultural interventions are subject to a variety of influences that can alter their efficacy and outcomes. The implementation of the intervention can

vary significantly across different areas or institutions, influenced by local contexts, resources, and management. This factor adds a layer of complexity to the abovementioned recipient status, where the experience of the intervention can differ greatly among individuals, shaping its relevance and effectiveness on a personal level.

100

Technology-Induced Marginalization of Rural Communities:

The agricultural R&D for rural development primarily aims to increase farm productivity, reduce dependence on external inputs, and enhance system resilience. However, the deployment of these technologies can sometimes lead to socially unfavorable outcomes, particularly contributing to the marginalization of certain farming communities and laborers (Graeub et al. 2016; Bouwman et al. 2021).

This marginalization is a critical issue, encompassing various dimensions of social inequality and exclusion, and technology can inadvertently exacerbate these issues in several ways:

- Access and Affordability: Advanced agricultural technologies (e.g., tractors) often come with high upfront costs, making them inaccessible to smallholder farmers or marginalized communities who lack financial resources. This economic barrier can widen the gap between affluent, large-scale farmers and their less affluent counterparts, leading to increased social inequality. While service provision of machinery can reduce the intensity of the problem, the timely availability and equal access to the services depend on several contextual factors.
- Skill and Knowledge Gap: The successful implementation of new technologies frequently requires specialized knowledge and skills. Farmers in marginalized communities may not have access to the necessary training and education, thereby preventing them from leveraging these technologies effectively. This can result in a knowledge divide, where only a fraction of the farming population benefits from technological advancements.
- Labor Displacement: Mechanization and chemical weeding can lead to labor displacement, where manual labor is replaced by machines/herbicides. While this can increase efficiency, it can also lead to unemployment or underemployment among agricultural workers, especially those in lower-skilled jobs (Bouwman et al. 2021). This displacement can disproportionately affect marginalized groups, deepening the existing socio-economic divides.
- Cultural and Social Disruption: Agricultural practices are deeply intertwined with cultural and social structures in many communities. The introduction of new technologies can disrupt these traditional practices and social norms, potentially leading to social disintegration or the loss of cultural heritage, particularly if the technologies are not aligned with the local context.
- Resource Allocation and Environmental Impact: While certain technologies aim to optimize resource use, they can also lead to environmental degradation if not properly managed or if they encourage the intensive use of natural resources. This can have detrimental effects on local communities, especially those that rely heavily on natural resources for their livelihoods.
- Market Dynamics and Power Structures: The adoption of advanced technologies can alter market dynamics and power structures within agricultural sectors. Large-scale farmers who can afford these technologies may gain disproportionate market power, further marginalizing small-scale farmers and reinforcing existing inequities in market access and pricing.

- Dependency and Resilience: Over-reliance on certain technologies can lead to dependency, reducing farmers' self-sufficiency and resilience.

- For example, heavy dependence on proprietary seeds or chemicals, when the input markets are not monitored and regulated by the government, can leave farmers vulnerable to price hikes, market fluctuations, or disruptions in supply chains.
- The "Progressive Farmer Fallacy": The dissemination process of agricultural technologies, often channelled through lead farmers who are typically large-scale and from non-marginalized castes, can inadvertently perpetuate social exclusion and deepen existing disparities. These so-called "progressive farmers", regarded as early adopters and influencers within farming communities, are usually selected for their ability to invest in and manage new technologies, resulting in a dissemination model that inherently favours the more affluent and socially dominant groups.
- Consequently, smallholder and marginalized caste farmers find themselves at the periphery of this technology transfer process. They face barriers not just in accessing these technologies due to their limited resources, but also in integrating into networks that receive first-hand knowledge and support. This selective dissemination creates a two-tier system in agricultural development where the benefits of innovation disproportionately accrue to those already in a position of advantage, further entrenching socio-economic and caste-based inequalities. The challenge of the extension system is to override the "Progressive Farmer Fallacy" through reimagining dissemination strategies to be more inclusive, ensuring that technology transfer and the accompanying knowledge and benefits flow equitably across the entire spectrum of the farming community.

Addressing these challenges requires a nuanced approach to the integration of technology in agriculture. It involves ensuring equitable access to technology, providing comprehensive training and support, aligning technological solutions with local needs and contexts, and fostering inclusive policies that protect and empower the most vulnerable segments of the rural population.

5. Case Study 1: Impact of Herbicide Adoption on Casual Labourers

The first case-study, coauthored by Maxwell Mkondiwa, CIMMYT (Delhi), addresses the intricate challenge of weed management, a significant hurdle in the implementation of sustainable and resource-conserving agricultural practices. As we strive for SI in agriculture, weed control presents profound trade-offs. Conservation Agriculture (CA), for instance, often relies on the use of herbicides for effective weed management. Similarly, practices like Direct Seeded Rice (DSR), which offer benefits such as moisture conservation and reduced labor costs, also face the dilemma of increased weed growth, necessitating reliance on herbicides. These interventions, while aiming to enhance productivity and economic outcomes by mitigating yield losses through weeding, must also navigate the tightrope of environmental stewardship. The choice of weedicides is critical, with some, like a combination of Sulfosulforon and Metsulfuron, posing less mammalian toxicity compared to others, such as 2,4-D. This difference is particularly important given the escalating concerns over

occupational hazards to farmers, health risks to consumers, pollution of watersheds, and the emergence of resistant weed species like *Phalaris minor*.

The perceived rise in farm wages coupled with the scarcity of family labor has catalyzed a shift towards labor-saving agricultural technologies such as machinery and herbicides. This shift, while ostensibly a response to economic and labor market dynamics, carries significant social implications. There is mounting evidence that the introduction of such technologies has led to the displacement of labor from women and socially marginalized caste groups. For example, research from India has highlighted how mechanization has specifically undercut women's weeding labor (Afridi et al. 2023). Similarly, in Malawi, the adoption of herbicides has resulted in the displacement of Ganyu labor, which refers to casual, often agricultural, labor (Bouwman et al. 2021).

Against this backdrop, the objectives of the present study are twofold: firstly, to investigate whether the surging herbicide use in regions like Bihar, India, has disproportionately affected the labor demands for historically marginalized groups and women, especially in weed management and other on-farm tasks. Secondly, we aim to propose a task-based approach to inequality as a robust framework for examining gender and social inclusion within the context of the unintended impacts of agricultural technologies. This approach allows for a granular analysis of how such technologies reshape the agricultural labor landscape and the socioeconomic status of vulnerable groups within it.

Through a household survey conducted in Bihar during 2021/22, a sample of 2725 rural households was generated, of which about 20% were identified as farm laborers. This survey was comprehensive, gathering data on critical parameters such as the year of first adoption of herbicides, along with detailed accounting of labor hours disaggregated by gender and categorized by historically marginalized or non-marginalized caste groups. We applied task-based production function theory, which allowed us to not only align the collected information with established stylized facts but also to pinpoint key moments and patterns within the dataset. Through this analytical framework, we sought to understand the ramifications of herbicide use on labor dynamics and to elucidate the nuanced impacts on different social strata within the agricultural community. This approach enables a nuanced assessment of technology's role in shaping agricultural labor, providing insights into the changing contours of labor engagement across gender and social groupings in the context of evolving farming practices.

In Bihar, there's a discernible trend where wheat yield gains and partial profits are notably higher when using safer, albeit less commonly adopted herbicides such as Metsulfuron and Sulfosulfuron, compared to the more widely used 2,4-D. Despite this, herbicide adoption has been rising sharply in the region. The task of herbicide application is predominantly undertaken by male laborers when outsourced, while hand weeding, the traditional alternative to herbicides, is primarily a job for female laborers.

Farmers in Bihar tend to hire labor within their own caste or from more marginalized caste groups. It is observed that women from marginalized castes are more likely to be hired for weeding jobs than women from non-marginalized castes. This dynamic is crucial, as the increasing shift to herbicide

use may inadvertently lead to the displacement of marginalized women laborers. Such displacement not only deprives these women of a vital source of income but also risks exacerbating existing gender and caste inequalities.

The implications of this shift extend beyond agricultural practices, signaling potential upheavals in the socio-economic structures that govern rural livelihoods.

The findings from our case-study bring forth significant policy implications. The trade-offs inherent in weed management strategies within SI frameworks such as CA and DSR necessitate a delicate balance between agricultural productivity and environmental and social equity. The introduction of labor-saving technologies should be complemented with comprehensive training programs for both men and women, ensuring that these technologies are accessible to a broader demographic and do not inadvertently marginalize certain groups.

For those displaced by technological advancements, the establishment of social safety nets, including unemployment benefits and job retraining programs, can provide necessary support during transitions to alternative employment. Policies must explicitly address gender and caste disparities in agricultural labor markets, aiming to foster inclusivity and equality through targeted interventions for the marginalized.

While some of the technological advancements in agriculture promise greater yields and profits, they also pose significant risks to environmental sustainability and social equity. Our research indicates that the effects of these advancements are not uniformly felt, with marginalized women being particularly vulnerable to displacement and loss of income. This evidence calls for a nuanced and multifaceted policy response that recognizes the complex interplay between technology, labor, and social hierarchies. Ultimately, the path forward lies in crafting agricultural policies that not only drive productivity but also uphold environmental stewardship and social justice, ensuring that the fruits of SI are shared equitably across all segments of society, including not only farmers but also agricultural laborers.

6. Case Study 2: Impacts of Targeting Women through Self-Help Groups

Women play a pivotal role in the SI of agri-food systems, contributing significantly to agricultural production, food security, and the overall well-being of rural communities (FAO 2023). Despite facing various challenges, including limited access to resources, decision-making, and markets, women's involvement in agriculture is crucial for the success of SI initiatives. Women face several challenges in adopting and benefitting from SI technologies, as they often have less access to vital agricultural resources such as land, credit, inputs, and training compared to men. Women's decision-making power within households and communities is often limited, affecting their ability to implement changes and innovations in agricultural practices (Acosta et al. 2020). These farmers face challenges in accessing markets due to gender norms, mobility constraints, and lack of market information, affecting their ability to sell their produce and earn a fair income (Surendran-Padmaja et al. 2023). They typically bear a disproportionate share of household and caregiving responsibilities, in addition to agricultural work (Khed and Krishna 2023). This "double burden" can limit their

capacity to engage in more profitable but time-consuming SI technologies.

Recognizing and enhancing the role and contribution of women in the SI of agri-food systems is not only a matter of gender equity but also a critical component of achieving broader agricultural and development goals (Aryal et al. 2020; Satyavathi et al. 2010). Empowering women and ensuring their full participation can lead to more sustainable, productive, and resilient agri-food systems. Need-based training for women farmers, gendered elicitation of preferences during technology development, group-based (e.g., women's self-help groups or SHGs) and gender-sensitive extension approaches, and increased share of women extension staff, etc., are identified as strategies toward better access of extension services to women farmers in India (Uma et al. 2015).

Conventionally, SHGs have been used as a tool for women's financial inclusion, mainly through microfinance programs. Studies have shown that women's participation in the SHGs positively affected their economic and political engagement, mobility, and social networking (Brody et al. 2017). Similar effects are noted in India also (Kumar et al. 2018). In the country, most state governments have unique SHG programs, such as "Mission Shakti" in Odisha, "Mahalir Thittam" in Tamil Nadu, "Kudumbashree" in Kerala, "Jeevika" in Bihar, etc. (Ashalakshmi et al. 2020). Women's SHGs have a short but remarkable history of aiding the dissemination of information, technologies, and inputs in the agricultural sector. The involvement of SHGs in agricultural development is accelerated by the gender mandate of certain government schemes. The Indian government program, "Mahila Kisan Sashaktikaran Pariyojana" (MKSP), which is a sub-component of the National Livelihood Rural Mission (NRLM), aims to empower women in agriculture through targeted investments for yield enhancement (source: http://mksp.gov.in/). Despite these new initiatives that make the involvement of SGHs in agricultural development mandatory, only a few studies have so far examined the effectiveness of the SHG-oriented extension approach to increase female farmers' empowerment and augment their livelihoods. Among the few existing studies, Raghunathan et al. (2019) showed that while participation in SHGs increased women's access to information and inputs in decision-making, it generated only a limited impact on agricultural practices. The present study examines the impact of an SHG-based intervention in popularizing maize in rice fallows in Mayurbhanj, an eastern Odisha district.

The study, carried out as a collaborative research project between CIMMYT and International Rice Research Institute (IRRI), focuses in on the transformative potential of a women-centric R&D initiative aimed at the SI of rice-fallow systems in Odisha State, India, particularly focusing on the empowerment of women through their engagement in the program. By introducing maize as a new cash crop through methods such as demonstration trials, field days, and farmer training sessions — all mediated via women's SHGs — this initiative sought to augment farm-household income in Mayurbhanj District. Leveraging a substantial dataset comprising 1,005 women farmers, the study evaluates the adoption of maize and its subsequent impact on women's empowerment, as measured by the Abbreviated Women's Empowerment in Agriculture Index (a-WEAI).

The findings emphasize the multifaceted ways in which targeted cash crop dissemination can enhance women's agency in agriculture. Notably, the study highlights that engaging woman farmers through SHGs not only fosters their active participation in community activities but also bolsters their

autonomy and control over agricultural resources. However, the conventional application of SHGs primarily for enhancing rural women's financial independence, typically through micro-credit and savings, has meant that the potential of SHG-based extension in agricultural settings remains underexplored. Hence, there's a compelling need for further R&D investment to refine the methodologies of SHG engagement, enhance the skills of extension personnel, and ensure that this approach becomes more effective, participatory, and inclusive.

The research also stresses the need for a nuanced, multi-faceted strategy in technology development and dissemination, one that acknowledges and integrates gender-specific preferences within the broader framework of SI. The study contributes to a growing body of literature that recognizes the necessity of explicit empowerment objectives in agricultural development projects. It highlights the importance of not only examining the direct outcomes of agricultural interventions on women and marginalized communities but also exploring the broader impact pathways, ensuring that the empowerment effects observed can be replicated and sustained across different crops and contexts. This comprehensive approach is critically important for achieving truly inclusive agrarian development and necessitates increased investment to realign institutional frameworks and mindsets towards gender-intentional, sustainable agricultural intensification.

7. Conclusion and Strategies for Inclusive Growth

The abovementioned case studies illuminate the intricate dynamics within the realm of SI of agriculture. Both studies address the changes in labor use and demand in agriculture due to the adoption of new technologies. In Case Study 1, there's a notable shift towards labor-saving agricultural technologies like herbicides, prompted by the perceived scarcity of labor and rising farm wages, leading to the displacement of labor, especially among women and marginalized groups. Similarly, Case Study 2 emphasizes the role of women in agriculture and the challenges they face due to limited access to resources and decision-making, which can affect their adoption of SI practices. Another recurring theme in both case studies is the focus on gender and social inclusion. Case Study 1 examines the impact of herbicide use on labor demands, particularly for marginalized groups and women, while proposing a task-based approach to understand the implications of technological changes on these groups. Case Study 2 underscores the significance of women in SI and the need for strategies like need-based training, group-based extension approaches, and increased share of women extension staff to ensure women's access to SI technologies in agriculture.

These studies suggest significant policy implications, advocating for a balance between agricultural productivity, environmental stewardship, and social equity. Case Study 1 calls for policies to promote safer herbicides, support labor-intensive farming practices, and ensure comprehensive training for both men and women to prevent the marginalization of certain groups. Case Study 2 emphasizes the

need for a nuanced, multi-faceted strategy in technology development and dissemination that integrates gender-specific preferences and a focus on explicit empowerment objectives in agricultural development projects.

Both case studies acknowledge the challenges in the adoption of SI practices, especially among women. Case Study 1 notes the increased reliance on herbicides in SI practices, which comes with environmental and health concerns. Case Study 2, on the other hand, highlights the barriers women face in accessing resources, decision-making power, and markets, which limit their capacity to engage in SI practices effectively.

To foster the equitable adoption of SI practices, it is imperative that policies are crafted through the inclusive engagement of marginalized communities, ensuring that their unique needs and challenges are adequately addressed. This collaborative approach is not only central to tailoring policies that mitigate, rather than exacerbate, social inequalities, but also crucial in recognizing and capturing the heterogeneous effects of SI on various segments of the population in impact evaluations.

Ensuring equitable access to essential resources such as land, water, and credit forms the backbone of this initiative. Implementing comprehensive land reforms, securing land tenure, and establishing fair water management systems are foundational steps towards creating a level playing field for marginalized farmers. In addition, targeted education, training, and extension services are vital in equipping these farmers and laborers with the necessary skills and knowledge to effectively embrace SI practices, thereby enhancing their productivity and livelihoods. To translate these efforts into tangible economic resilience, it is critical to improve market access for marginalized farmers, advocate for fair trade practices, and foster value addition in their agricultural products. These initiatives not only ensure that farmers receive fair compensation for their produce but also bolster their economic stability.

Addressing gender-specific challenges within agriculture is essential to credit SI as socially inclusive. This entails guaranteeing women's access to vital resources, bolstering their decision-making authority, and actively involving them in training and development programs. The implementation of robust social protection programs can serve as a crucial safety net, aiding marginalized farmers and laborers in coping with risks and shocks. These programs pave the way for more equitable participation in SI practices, ensuring that the benefits of SI are distributed fairly across all strata of society. To sum up, while crafting policies promoting SI, it is essential to incorporate mechanisms for capturing and addressing the heterogeneous impacts of the various interventions proposed.

References

Acosta, Mariola; van Wessel, Margit; van Bommel, Severine; Ampaire, Edidah L.; Twyman, Jennifer; Jassogne, Laurence; Feindt, Peter H. (2020): What does it mean to make a 'joint' decision? Unpacking intra-household decision making in agriculture: Implications for policy

and practice. In *The Journal of Development Studies* 56 (6), pp. 1210–1229. DOI: 10.1080/00220388.2019.1650169.

Adhikari, Prabhakar; Araya, Hailu; Aruna, Gerald; Balamatti, Arun; Banerjee, Soumik; Baskaran, P. et al. (2018): System of crop intensification for more productive, resource-conserving, climate-resilient, and sustainable agriculture: experience with diverse crops in varying agroecologies.

In *International Journal of Agricultural Sustainability* 16 (1), pp. 1–28. DOI: 10.1080/14735903.2017.1402504.

Afridi, Farzana; Bishnu, Monisankar; Mahajan, Kanika (2023): Gender and mechanization: Evidence from Indian agriculture. In *American Journal of Agricultural Economics* 105 (1), pp. 52–75. DOI: 10.1111/ajae.12315.

Alwang, Jeffrey; Gotor, Elisabetta; Thiele, Graham; Hareau, Guy; Jaleta, Moti; Chamberlin, Jordan (2019): Pathways from research on improved staple crop germplasm to poverty reduction for smallholder farmers. In *Agricultural Systems* 172, pp. 16–27. DOI: 10.1016/j.agsy.2017.10.005.

Aryal, Jeetendra Prakash; Farnworth, Cathy R.; Khurana, Ritika; Ray, Srabashi; Sapkota, Tek B.; Rahut, Dil Bahadur (2020): Does women's participation in agricultural technology adoption decisions affect the adoption of climate-smart agriculture? Insights from Indo-Gangetic Plains of India. In *Review of Development Economics*. DOI: 10.1111/rode.12670.

Ashalakshmi, R. K.; John, Anju; Reshma, T. R. (2020): Contribution of microfinance to self help groups for rural development in India. In *Journal of Science, Technology and Management* 13 (4), pp. 237–241.

Barrett, C. B.; Bezuneh, M.; Clay, D. C.; Reardon, T. (2001): Heterogeneous Contraints, Incentives, and Income Diversification Strategies in Rural Africa. Working Paper 2001-25. Ithaca, USA: Cornell University.

Bouwman, T. I.; Andersson, J. A.; Giller, K. E. (2021): Adapting yet not adopting? Conservation agriculture in Central Malawi. In *Agriculture, Ecosystems & Environment*.

Brody, Carinne; Hoop, Thomas de; Vojtkova, Martina; Warnock, Ruby; Dunbar, Megan; Murthy, Padmini; Dworkin, Shari L. (2017): Can self-help group programs improve women's empowerment? A systematic review. In *Journal of Development Effectiveness* 9 (1), pp. 15–40. DOI: 10.1080/19439342.2016.1206607.

Christiaensen, Luc; Demery, Lionel; Kuhl, Jesper (2011): The (evolving) role of agriculture in poverty reduction: An empirical perspective. In *Journal of Development Economics* 96 (2), pp. 239–254. DOI: 10.1016/j.jdeveco.2010.10.006.

Dawson, Neil; Martin, Adrian; Camfield, Laura (2019): Can agricultural intensification help attain Sustainable Development Goals? Evidence from Africa and Asia. In *Third World Quarterly* 40 (5), pp. 926–946. DOI: 10.1080/01436597.2019.1568190.

FAO (2023): The Status of Women in Agrifood Systems. Rome: Food and Agriculture Organisation of the United Nations (FAO).

Garnett, T.; Appleby, M. C.; Balmford, A.; Bateman, I. J.; Benton, T. G.; Bloomer, P. et al. (2013): Sustainable intensification in agriculture: Premises and policies. In *Science* 341 (6141), pp. 33–34. DOI: 10.1126/science.1234485.

Gibbs, H. K.; Ruesch, A. S.; Achard, F.; Clayton, M. K.; Holmgren, P.; Ramankutty, N.; Foley, J. A. (2010): Tropical forests were the primary sources of new agricultural land in the 1980s and 1990s. In *Proceedings of the National Academy of Sciences of the United States of America* 107 (38), pp. 16732–16737. DOI: 10.1073/pnas.0910275107.

Graeub, Benjamin E.; Chappell, M. Jahi; Wittman, Hannah; Ledermann, Samuel; Kerr, Rachel Bezner; Gemmill-Herren, Barbara (2016): The State of Family Farms in the World. In *World Development* 87, pp. 1–15. DOI: 10.1016/j.worlddev.2015.05.012.

Hertel, Thomas W.; Rosch, Stephanie D. (2010): Climate Change, Agriculture and Poverty. Policy Research Working Paper 5468. Washington, D.C.: World Bank.

Ivanic, Maros; Martin, Will (2018): Sectoral productivity growth and poverty reduction: National and global impacts. In *World Development* 109, pp. 429–439. DOI: 10.1016/j.worlddev.2017.07.004.

Jain, Meha; Solomon, Divya; Capnerhurst, Hagan; Arnold, Anthony; Elliott, Alice; Kinzer, Andrew T. et al. (2020): How much can sustainable intensification increase yields across South Asia? a systematic review of the evidence. In *Environmental Research Letters* 15 (8), p. 83004. DOI: 10.1088/1748-9326/ab8b10.

Jat, R. S.; Choudhary, R. L.; Singh, H. V.; Meena, M. K.; Singh, V. V.; Rai, P. K. (2021): Sustainability, productivity, profitability and soil health with conservation agriculture based sustainable intensification of oilseed brassica production system. In *Sci Rep* 11 (1), p. 13366. DOI: 10.1038/s41598-021-92801-z.

Jones-Garcia, Eliot; Krishna, Vijesh V. (2021): Farmer adoption of sustainable intensification technologies in the maize systems of the Global South: A review. In *Agronomy for Sustainable Development* 41, p. 8.

Khed, Vijayalaxmi D.; Krishna, Vijesh V. (2023): Agency and time poverty: Linking decision-making powers and leisure time of male and female farmers of central India. In *World Development Perspectives* 29, p. 100484. DOI: 10.1016/j.wdp.2022.100484.

Kotu, Bekele H.; Alene, Arega; Manyong, Victor; Hoeschle-Zeledon, Irmgard; Larbi, Asamoah (2017): Adoption and impacts of sustainable intensification practices in Ghana. In *International Journal of Agricultural Sustainability* 15 (5), 539-554. DOI: 10.1080/14735903.2017.1369619.

Krishna, Vijesh V.; Euler, Michael; Siregar, Hermanto; Qaim, Matin (2017): Differential livelihood impacts of oil palm expansion in Indonesia. In *Agricultural Economics* 48 (5), pp. 639–653. DOI: 10.1111/agec.12363.

Krishna, Vijesh V.; Veettil, Prakashan C. (2014): Productivity and efficiency impacts of conservation tillage in northwest Indo-Gangetic Plains. In *Agricultural Systems* 127, pp. 126–138. DOI: 10.1016/j.agsy.2014.02.004.

Krishna, Vijesh V.; Yigezu, Yigezu A.; Karimov, Aziz A.; Erenstein, Olaf (2020): Assessing technological change in agri-food systems of the Global South: A review of adoption-impact studies in wheat. In *Outlook on Agriculture* 49 (2), pp. 89–98. DOI: 10.1177/0030727020930728.

Kumar, Neha; Scott, Samuel; Menon, Purnima; Kannan, Samyuktha; Cunningham, Kenda; Tyagi, Parul et al. (2018): Pathways from women's group-based programs to nutrition change in South Asia: A conceptual framework and literature review. In *Global Food Security*. DOI: 10.1016/j.gfs.2017.11.002.

Kumar, Surender; Khanna, Madhu (2023): Distributional heterogeneity in climate change impacts and adaptation: Evidence from Indian agriculture. In *Agricultural Economics* 54 (2), pp. 147–160. DOI: 10.1111/agec.12765.

Kuyah, Shem; Sileshi, Gudeta Weldesemayat; Nkurunziza, Libère; Chirinda, Ngonidzashe; Ndayisaba, Pierre Celestin; Dimobe, Kangbéni; Öborn, Ingrid (2021): Innovative agronomic practices for sustainable intensification in sub-Saharan Africa. A review. In *Agronomy for Sustainable Development* 41 (2). DOI: 10.1007/s13593-021-00673-4.

Molotoks, Amy; Smith, Pete; Dawson, Terence P. (2021): Impacts of land use, population, and climate change on global food security. In *Food and Energy Security* 10 (1), Article e261. DOI: 10.1002/fes3.261.

Paltasingh, Kirtti Ranjan; Goyari, Phanindra (2018): Impact of farmer education on farm productivity under varying technologies: Case of paddy growers in India. In *Agricultural and Food Economics* 6 (1). DOI: 10.1186/s40100-018-0101-9.

Pantera, A.; Mosquera-Losada, M. R.; Herzog, F.; Herder, M. den (2021): Agroforestry and the environment. In *Agroforestry Systems* 95 (5), pp. 767–774. DOI: 10.1007/s10457-021-00640-8.

Paudel, Gokul P.; Gartaula, Hom; Rahut, Dil Bahadur; Craufurd, Peter (2020): Gender differentiated small-scale farm mechanization in Nepal hills: An application of exogenous switching treatment regression. In *Technology in Society* 61, p. 101250. DOI: 10.1016/j.techsoc.2020.101250.

Pimentel, David; Berger, Bonnie; Filiberto, David; Newton, Michelle; Wolfe, Benjamin; Karabinakis, Elizabeth et al. (2004): Water resources: Agricultural and environmental issues. In *BioScience* 54 (10), p. 909. DOI: 10.1641/0006-3568(2004)054[0909:WRAAEI]2.0.CO;2.

Plewis, Ian (2002): Modelling impact heterogeneity. In *Journal of the Royal Statistical Society Series A: Statistics in Society* 165 (1), pp. 31–38. DOI: 10.1111/1467-985X.0asp1.

Raghunathan, Kalyani; Kannan, Samyuktha; Quisumbing, Agnes R. (2019): Can women's self-help groups improve access to information, decision-making, and agricultural practices? The Indian case. In *Agricultural Economics* 50 (5), pp. 567–580. DOI: 10.1111/agec.12510.

Satyavathi, C. Tara; Bharadwaj, Ch.; Brahmanand, P. S. (2010): Role of farm women in agriculture. In *Gender, Technology, and Development* 14 (3), pp. 441–449. DOI: 10.1177/097185241001400308.

Sharma, H.R (2023): Patterns, sources and determinants of agricultural growth in India. In *Indian Journal of Agricultural Economics* 78 (1), pp. 26–70.

Signé, Landry; Munyati, Chido (2023): How Africa's new Free Trade Area will turbocharge the continent's agriculture industry. Cologny/Geneva, Switzerland: World Economic Forum (WEF). Available online at https://www.weforum.org/agenda/2023/03/how-africa-s-free-trade-area-will-turbocharge-the-continent-s-agriculture-

industry/#:~:text=URL%3A%20https%3A%2F%2Fwww.weforum.org%2Fagenda%2F2023%2F03%2Fhow, checked on 1/28/2024.

Song, Fujian; Hooper; Loke, Yoon (2013): Publication bias: what is it? How do we measure it? How do we avoid it? In *Open Access Journal of Clinical Trials*, p. 71. DOI: 10.2147/OAJCT.S34419.

Surendran-Padmaja, Subash; Khed, Vijayalaxmi D.; Krishna, Vijesh V. (2023): What would others say? Exploring gendered and caste-based social norms in Central India through vignettes. In *Women's Studies International Forum* 97, p. 102692. DOI: 10.1016/j.wsif.2023.102692.

Tilman, David; Cassman, Kenneth G.; Matson, Pamela A.; Naylor, Rosamond; Polasky, Stephen (2002): Agricultural sustainability and intensive production practices. In *Nature* 418 (6898), pp. 671–677. DOI: 10.1038/nature01014.

Tran-Nam, Quoc; Tiet, Tuyen (2022): The role of peer influence and norms in organic farming adoption: Accounting for farmers' heterogeneity. In *Journal of Environmental Management* 320, p. 115909. DOI: 10.1016/j.jenvman.2022.115909.

Tscharntke, Teja; Clough, Yann; Wanger, Thomas C.; Jackson, Louise; Motzke, Iris; Perfecto, Ivette et al. (2012): Global food security, biodiversity conservation and the future of agricultural intensification. In *Biological Conservation* 151 (1), pp. 53–59. DOI: 10.1016/j.biocon.2012.01.068.

Uma, Sah; Kumar, Dubey Shantanu; Singh S. K.; Kumar, Rajesh; Singh, Deepak; Krishna, Radha (2015): Mainstreaming women farmers to agricultural extension services in India: Perception of extension personnel. In *Indian Journal of Extension Education* 51 (3 & 4), pp. 1–7.

Socio-economic impacts of Sustainable Agriculture

Krishna Kumar Patel[1], Veerendra Singh[2], Rishikesh Yadav[3], Ajay Kumar Baheliya[4]

[1,2,3] Department of Soil Science and Agricultural Chemistry, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (U.P.) – 2080022

[4] Department of Soil Science and Agricultural Chemistry, Acharya Narendra Dev University of Agriculture & Technology, Ayodhya (U.P.) – 224229

Abstract

The Socio-Economic Impacts of Sustainable Agriculture are multifaceted, encompassing a spectrum of positive changes in agricultural practices that prioritize environmental stewardship, social equity, and economic resilience. Sustainable agriculture represents a paradigm shift from conventional methods, emphasizing the long-term health of ecosystems and the well-being of communities. This abstract explores the key dimensions of its socio-economic impacts.

Firstly, environmentally, sustainable agriculture promotes soil health, biodiversity, and water conservation. By minimizing chemical inputs and adopting agro ecological practices, it mitigates environmental degradation, ensuring the resilience of agricultural systems in the face of climate change. Socially, sustainable agriculture fosters inclusive and equitable development. It empowers local communities by promoting fair labor practices, gender equality, and enhancing food security. Community engagement in decision-making processes and the preservation of traditional knowledge contribute to a more sustainable and resilient food system. Economically, the adoption of sustainable agriculture practices leads to increased efficiency and cost-effectiveness over time. Diversification of crops and the incorporation of innovative technologies contribute to enhanced productivity and profitability for farmers. Additionally, sustainable agriculture fosters market access for environmentally conscious consumers, creating new economic opportunities and markets for sustainable products.

In conclusion, the socio-economic impacts of sustainable agriculture extend beyond the farm gate, influencing environmental conservation, social equity, and economic prosperity. This abstract provides a glimpse into the transformative potential of sustainable agriculture in addressing the complex challenges facing our global food systems.

Keywords: Sustainable Agriculture, Food Security, Environmental Conservation

Economic benefits of transitioning to sustainable farming methods

Apoorva Singh[1], Priya Singh2 & Shivam Singh[3]

[1&2] Research Scholar (PhD), Department of Extension Education and Communication Management, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, (U.P),

[3] Research Scholar (PhD), Department of Agricultural Extension, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, (U.P) India

Corresponding author: apoorva.singh9415@gmail.com

Abstract

The transition to sustainable farming methods presents a myriad of economic benefits that extend beyond the agricultural sector, influencing both local and global economies. Sustainable farming practices prioritize environmental stewardship, resource efficiency, and long-term resilience, contributing to enhanced economic stability. Reduced reliance on synthetic inputs, such as fertilizers and pesticides, leads to lower production costs and improved profitability for farmers. Moreover, sustainable agriculture fosters soil health and biodiversity, safeguarding long-term productivity and mitigating the economic risks associated with soil degradation.

The adoption of sustainable farming practices also addresses market demands for eco-friendly products, opening new avenues for revenue generation. As consumers increasingly prioritize ethically produced, organic goods, farmers embracing sustainability gain a competitive edge in the market. Additionally, sustainable farming fosters job creation in rural communities, supporting local economies. The reduction of greenhouse gas emissions associated with sustainable practices contributes to mitigating climate change, averting potential economic losses from extreme weather events and environmental degradation.

Governments and businesses are recognizing the economic advantages of sustainable agriculture, investing in research, incentives, and infrastructure to facilitate the transition. Overall, the economic benefits of transitioning to sustainable farming methods are multifaceted, encompassing cost savings, market competitiveness, job creation, and resilience to climate change, positioning sustainable agriculture as a cornerstone for a thriving and resilient global economy.

Key Words: climate change, economic, farming, infrastructure, sustainable

Socio-Economic Impacts of Sustainable Agriculture

[1]Smita Singh, [2] R. K. Doharey,[3] N.R. Meena

[1]Research Scholar, [2] Professor, [3] Assistant Professor, A.N.D.U.A. & T. Kumarganj, Ayodhya

Abstract

Sustainable agriculture methods serve a crucial role in maintaining food security while simultaneously creating good socio-economic outcomes. This approach to farming emphasizes environmentally conscientious approaches that reconcile economic viability with social equality. Crop diversification is a crucial component of sustainable agriculture that contributes to food security. Unlike monoculture, where a single crop dominates, sustainable farming encourages the cultivation of diverse crops. This not only enhances soil health but also safeguards against the risks associated with crop failures.

Crop diversification offers a more resilient and stable food supply, minimizing exposure to pests, diseases, and bad weather conditions. In turn, this resilience benefits directly to food security by sustaining stable harvests and preventing food shortages. Furthermore, sustainable agriculture supports efficient water management procedures. Through practices such as rainwater gathering, drip irrigation, and soil moisture conservation, farmers can maximize water consumption in agriculture. This not only tackles the challenge of water scarcity but also boosts agricultural yield. Efficient water management is crucial for ensuring a steady supply of water for crops, especially in regions prone to drought, thereby bolstering food security. From a socio-economic perspective, sustainable agriculture practices have far-reaching implications.

The focus on agro-ecological techniques lessens reliance on expensive inputs from outside sources, such as pesticides and synthetic fertilizers. This not only decreases production costs for farmers but also increases their economic resiliency. Furthermore, sustainable practices frequently result in job opportunities, especially in small-scale farming, which helps to combat poverty and promote rural development. Market opportunities are impacted by socio-economic factors as well. Niche markets for organic and locally sourced goods have emerged as a result of the rising demand for food that is produced sustainably. This promotes local communities' economic empowerment by giving small-scale farmers opportunities for entrepreneurship and revenue production.

In conclusion, sustainable agriculture methods form a cornerstone for achieving both food security and excellent socio-economic outcomes. By encouraging resilience, resource efficiency, and equal economic possibilities, sustainable agriculture stands as a transformative force in constructing a more secure and prosperous future for communities globally.

Keywords: viability, bolstering, efficient, niche, resilience.

Buying Behaviour of Consumers towards Millet Based Food Products in Andhra Pradesh, Odisha & Telangana states of India

Buduru. Salome Yesudas
Steering Committee Member Millet network of India (MINI)

Abstract

MINI works across India, chose three towns to study the consumption of millets: Anakapalli in Andhra Pradesh, Sangareddy in Telangana, and Rayagada in Odisha. The study used a purposive sampling method to select 300 consumers from different socioeconomic classes across three towns in three different Indian states.

A simple questionnaire with relevant variables was designed to elicit the information. The data required for the study was gathered through personal interviews with the sample respondents. Some key factors that influenced the respondents to buy millet products were identified. The collected data was tabulated and analyzed using percentages, graphs. Study revealed that consumers perceived millet as healthy option and fortunately their preference of consumption is still Indian snacks so the entrepreneurs look for Haldiram's models of success through millet-based products. Millets are perceived as healthy food for all age groups.

Millet cultivation helps in conserving and continuing agrobiodiversity. Millet promotion empowers women farmers by running their own business at small scale. Expansion of millet consumers, based on their own choices will definitely enhance consumer's health and nutrition status but also leads to economic empowerment.

Key words: Millet foods, Health benefits, Source of Information, steady supply, Nutrition therapeutic diets

Socio-Economic Analysis on Apiculture: A case study in Tamil Nadu

B. Keerthika[1], M. Thilagavathi[2], C. Indu Rani[3], M. Prahadeeshwaran[4] and R. Vasanthi[5]

[1*]Research Scholar, [2]Professor, [4]Associate Professor, Department of Agricultural Economics, CARDS, TNAU, Coimbatore, [3]Professor and Head, Department of Vegetable Science, TNAU, Coimbatore, Department of Agricultural Economics, [5]Professor (Mathematics), Department of Social Sciences, HC&RI, Periyakulam

Abstract

Agricultural and Processed Food Products Export Development Authority (APEDA) has worked to stimulate exports by ensuring quality production and by expanding markets to new countries. The production of honey from India is increased due to the introduction of 'Sweet Revolution' in the year 2016.

The study analyses the growth rate in the production and export of honey from India by the Compound Annual Growth rate and the results suggested that both showed positive and significant growth rate of 13.85 percent and 14.67 percent, respectively. Beekeepers across Tamil Nadu was surveyed in the year 2022 to find the difference in the income of trainees over the non-trainees using the partial budgeting analysis.

The result showed that the trainees earned an additional income of Rs.7000 over the non-trainees. The major constraint in the beekeeping was collapse of bee colonies due to spraying of pesticides in the field near to apiary units. Hence government should introduce honey bee safe zone around the major apiary units that should reduce the damage to colonies.

Keywords: Trend, Compound growth, Partial budget, Trainees and non-trainees, Constraint

Trends analysis in production, consumption and trade of major Sudanese cereals commodities over the last three decades

Elgilany A. Ahmed (PhD)[1], Fatima Rahma Mohammed[2]
Agricultural Research Corporation (ARC), Central Ministries of Agriculture and Forests, Sudan.
Corresponding author: elgilanya@yahoo.com,

Abstract

The paper analyzes the major Sudanese commodities by examining trends in cereals, consumption and trade for a 10-years period (term) for the last three decades (1990 to 2021), and indicates the projections for production, consumption and demand up to 2030. The paper depended on secondary data collected mainly from annual statistics of the central Ministries of Agriculture and Forests for various years.

The findings have shown that the production of cereals crops namely, sorghum and millet shows highest annual growth rates respectively during the first and the third terms in the rain-fed sector, while wheat shows a high annual growth rate during the second and the third terms. It is clear that, total cereals consumption in the Sudan rose at an average annual rate higher than the production rate for the whole period of study. To meet the shortfall between wheat consumption and production, the crop and its flour imports increased. This has exerted a heavy burden on the country's development and create a negative trade balance due to deteriorating foreign exchange resources. Therefore, the expected improvement in wheat production needs to maximize the available domestic resources by using modern technologies rather than the expansion of cultivation areas, this will minimize the gap between potential yield and producer' yields. Sorghum is mainly grown for local consumption by small scale holders (60% of quantity produced) in main producing areas, particularly in traditional rain-fed farming, in semi-mechanized and in irrigated agriculture.

The period 2000 – 2010 was the period of oil export from Sudan which was the major source of foreign currency to the government neglecting traditional agricultural exports and the impact was a deterioration on agricultural export quantities leading to declining total values from all agricultural exports due to negligence of development of the sector impacting deterioration of existing infrastructure.

Keywords: Cereals, Commodities, Trend, Analysis, Sudan

Socio-economic impacts of sustainable agriculture

Hapalia S[1], Vaghasiya K[2], and Vekariya S[3]

[1&2] M. Sc. Scholar, Department of Soil Science and Agricultural Chemistry, College of Agriculture, Junagadh Agricultural University, Junagadh, [3] M. Sc. Scholar, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat)

Corresponding Author: surbhihapalia@gmail.com

Abstract

Sustainable agriculture, characterized by environmentally conscious and socially responsible practices, has emerged as a transformative force with profound implications for the socio-economic fabric of communities. This abstract encapsulates the multifaceted impacts of sustainable agriculture, addressing key dimensions such as job creation, income diversification, market access, community resilience, health and well-being, local food systems, community empowerment, and gender dynamics. By fostering labor-intensive methods, sustainable agriculture becomes a catalyst for increased employment opportunities, contributing to improved livelihoods and poverty reduction.

The promotion of diverse cropping systems and value-added activities enables farmers to diversify income streams, enhancing economic resilience. Consumer preferences for sustainably produced goods create market opportunities, with access to premium markets enhancing economic returns. Sustainable agriculture practices, including agroecology and organic farming, contribute to community resilience by reducing dependence on external inputs and fostering self-sufficiency, crucial in the face of climate variability. Positive health outcomes arise from reduced exposure to synthetic pesticides and the production of nutrient-rich foods, benefiting both farmers and consumers.

The development of local food systems strengthens community ties, supporting local economies and reducing reliance on centralized distribution networks. Community empowerment and participatory decision-making characterize sustainable agriculture, fostering shared responsibility for sustainable development. Gender dynamics shift as women play prominent roles in sustainable farming practices. This abstract encapsulates the intricate interplay of socio-economic impacts, emphasizing the holistic and transformative potential of sustainable agriculture in shaping resilient, equitable, and thriving communities.

Keywords: Sustainable Agriculture, Socio-economic, Impact.

Theme 7: Sustainable Crop Management

Rice-duck-fish: An integrated farming system for Sustained Production: A review

S.G. Suriya[1], J. Sivanantha[2] and V. Dharanidharan[3]
Post graduate student, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalainagar – 608 002
Corresponding author: sciencesuriya007@gmail.com

Abstract

Integrating agriculture with livestock components provides an excellent biome for the dynamic and transitional characters in rice fields. The main aim is to mitigate the biotic stress of rice (*Oryza sativa* L.) and boost the lucrativeness with the integrated component duck and fish in a natural manner for sustained production.

The integrated farming system (IFS) followed the principle of either organic or partially organic due to the intake of livestock. Therefore, the review is to evaluate the efficacy of Rice + Duck + Fish (RDF) structure to improve the physio-chemical properties, ecological balance, pre- and post-nutrient composition of the soil, addition of fecal matter supplied by integrated components, and land use efficiency (LUE). In continuation, an exotic duck breed White Pekin, is implemented in spite of native varieties to improve the efficiency criterion within a shorter duration for meat purposes. The weeds and pest population are the major factors of biotic stress that declined by RDF structure through scooping and feeding without implementation of agrochemicals.

Altering the RDF system instead of conventional practices tends to maximize the net returns, rice equivalent yield (REY), rural employability, endured food production and lower the input cost. Compared to conventional systems, RDF structure-based IFS will be an efficient climate resilience model under aberrant weather condition.

Keywords: IFS, RDF, White Pekin, Biotic stress, Climate resilience

An investigation on effect of Drum rolling practices in Groundnut crop yield

J. Sivanantha[1], S. G. Suriya[2] and A. Bharathi[3]

[1&3] Post Graduate Student, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai Nagar – 608 002, Chidambaram, Tamil Nadu, India. [2]Assistant Professor, Department of Agriculture, Kalasalingam Academy of Research and Education, Krishnankoil – 626 126, Virudhunagar, Tamil Nadu, India.

Corresponding Author: sivajayapandian@gmail.com

Abstract

A field experiment was conducted to investigate the effect of drum rolling practices in groundnut yield. The experiment was laid out in RBD with eight treatments and three replications. The eight treatments include T_1 - Drum rolling on 50 DAS, T_2 - Drum rolling on 60 DAS, T_3 - Drum rolling on 70 DAS, T_4 - Drum rolling on 50 and 60 DAS, T_5 - Drum rolling on 50 and 70 DAS, T_6 - Drum rolling on 60 and 70 DAS, T_7 - Drum rolling on 50, 60 and 70 DAS and T_8 - Conventional practice (without drum rolling). The certified Seed of groundnut *cv.* dharani (TCGS 1043) were sown. An empty iron drum (21kg) was used for drum rolling. The groundnut crop was fertilized with RDF of 25:50:75 kg ha^{-1} of NPK and applied gypsum at 400 kg ha^{-1} on 45th DAS with each bed size of 10 m^2 at spacing 30 × 15 cm.

From our investigation on effect of drum rolling practices in groundnut *cv.* dharani TCGS 1043, it may be concluded that significant influence of drum rolling on 70 DAS (T_3) recorded highest pod yield and BCR (1.97) compared to other drum rolling practiced fields and the conventional practice (without drum rolling).

Keywords: *G*roundnut, Dharani (TCGS 1043), Drum rolling, 70 DAS, Pod yield

Millets in Zero Budget Natural Farming: An approach for Sustainable Food Production and soil health

Veerendra Kumar Patel[1], Vivek Kumar Singh[2], Satwadhar P.P.[3], Bhavik J. Prajapati[4], Shubhangi Baseveshwar Avte[5] and Suraj Mishra[6]

[1, 2&3] Research scholar, Department of Natural Resource Management & Faculty of Agriculture Mahatma Gandhi Chitrakoot Gramodaya University, Chitrakoot, Satna (M.P)

[4.] Research scholar, Micronutrient Research Center, AAU, Anand, Gujrat, [5.] Research scholar, VNMKV Parbhani, Maharashtra, [6] Research scholar, BUAT Banda (U.P.)

[*]Corresponding authors – Veerendrapatel@gmail.com

Abstract

Zero budget Natural Farming (ZBNF) has emerged as a pivotal paradigm in modern agriculture, emphasizing sustainable practices to enhance crop productivity while preserving soil health and natural resources. Natural farming relies on four key principles: including care and maintenance of panchamaha booth (Soil, Air, Water, Fire), Soil as living entity, integrated plants, animals and human beings, Bio diversity and sustainable agriculture, and climate resilient practices. Millets have a significant role in the traditional diets of many regions throughout the country. Millets have various advantageous properties like drought resistant, good yielding in areas where water is limited and they possess good nutritive values.

In the agriculture systems of southern-Asia, the continuous practice of conventional input-intensive cereal-dominated production has largely contributed to soil degradation, depletion of underground water resources, and reduced land and water productivity, ultimately jeopardizing sustainable food production. Given this, researchers emphasize the pivotal role of crop diversification including millets in the system in order to conserve natural resources, foster soil health, and sustain crop productivity.

Experimental findings from diverse agro-ecologies provide evidence that the integration of millets in ZBNF not only contributes to enhanced agricultural sustainability but also holds the potential to address food security and nutrition challenges in an era marked by climate uncertainties and environmental degradation. Given the growing significance of millets in ZBNF, there is a pressing need for more systematic studies across diverse agro-regions to maximize the benefits of ZBNF. This article highlights the important role of millets in ZBNF, focusing on its potential benefits pertaining to sustainable crop production, resource conservation and soil health.

Key words: Drought resistant, Good nutritive values, Profitability, Sustainability, Soil health and ZBNF.

Role of Non-native Fish (NNF) in Advancing the Blue Revolution vis-a-vis Sustainability Challenges

Atul K Singh
Former Director, ICAR-Directorate of Coldwater Fisheries Research & Ex-Emeritus Scientist,
National Bureau of Fish Genetic Resources, Lucknow-226002
Corresponding author aksingh56@rediffmail.com/singhatk@gmail.com

Abstract

Blue Revolution aims at enhancing fish production through sustainable aquaculture practices. India's current fish production, relies on diverse non-native species (NNF) to boost its aquaculture output. Introduced NNF pangasius (*Pangasianodon hypophthalmus*), Nile tilapia (*Oreochromis niloticus*), North African catfish (*Clarias gariepinus*), pacu (*Piaractus brachypomus*), Chinese grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophthalmichthys molitrix*), bighead carp (*Hypophthalmichthys nobilis*), common carp (*Cyprinus carpio*), rainbow trout (*Oncorhynchus mykiss*) and even whiteleg shrimp (*Litopaeneus vannamei*) have demonstrated their adaptability and productivity in Indian waters.

The generated information shows that the introduction of these NNF species exhibit rapid growth rates, high reproductive capabilities, and adaptability to varying environmental conditions, contributing to increased efficiency in fish farming and productions. Moreover, the economic impact of these NNF species cannot be overstated since they have positively influenced the aquaculture sector by diversifying production and enhancing overall yields. Their market demand, coupled with favourable growth characteristics, has provided economic opportunities for fish farmers across the country. This economic upliftment is a crucial aspect of the Blue Revolution, aligning with its objectives of improving livelihoods and increasing income in the fisheries sector. However, the integration of NNF species also brings forth certain challenges and considerations.

Ecological impacts, potential competition with native species, and the risk of invasion are some of the aspects presented in this paper that demand careful monitoring and management. It is suggested that sustainable practices and responsible aquaculture approaches are essential to mitigate any adverse effects and ensure the long-term success of the Blue Revolution.

Keywords: Non-native fish; aquaculture; biodiversity; ecological impacts; regulations; management

Urban farming through Student READY in ICAR-SAU System for comprehensive food security

V.Rajendra Prasad[1], V.Chandra Sekhar[2], D.Uma Maheswara Rao[3], R.Saritha[4], Ch.Mukunda Rao[5], K.V.Ramana Murthy[6]and P.V.K. Jagannadha Rao[7]

[1.] Senior Scientist & Head, Department of Agricultural Economics, [2.] Senior Scientist, Department of Plant Pathology, [3.] Extension Specialist, Department of Agril. Extension, [4.] Principal Scientist, Department of Entomolgy, [5.] Principal Scientist (Plant Physiology), [6.] Principal scientist (Agronomy) and [7.] Associate Director of Research of Regional Agricultural Research Station, Anakapalle -531001, Acharya N.G. Ranga Agricultural University (ANGRAU).

Abstract

The overall urban development strategy of India needs a paradigm shift to sustainable and ecological urbanization. In this context, it is high time for the ICAR and SAU to make inroads into urban farming to offset the productivity pressures on rural areas, for enhancing food and nutritional security. So far our direct foot print is in rural areas only. The RAWEP and ELP semesters in the UG could have an additional option to reside in urban areas also.

Urban farming could be introduced in any of the five components i.e. Experiential Learning, Awareness Works Experience, In-Plant Training / Industrial attachment, Hands-on training (HOT)/Skill development training and Students Projects that were prescribed for Student READY program by ICAR. Aquaponics, Rooftop Urban Farm, Growing specialty crops for high end restaurants, Micro greens, edible flowers, and mushrooms can be some of the activities that can be undertaken by final year undergraduate students.

The modus operandi/ methodology might include exploring more underutilized spaces such as below highway viaducts, creating care farms for people with special needs, social enterprise farms, micro farms in obscure spaces, growing herbs and vegetables in offices as staff engagement & CSR, Community gardens and community composting and running a certificate course in urban agriculture.

Keywords: Urban farming, Urban food security, Nutritional security, Community gardens, Experiential learning.

Economics of Sorghum Production, Consumption and Trade in Sudan (1990 - 2020)

Elgilany A. Ahmed (PhD), Fatima Rahma Mohammed,
Agricultural Research Corporation (ARC)
Central Ministries of Agriculture and Forests, Sudan
Corresponding author: elgilanya@yahoo.com,

Abstract

This paper focuses on a set of high-potential of sorghum commodity in Sudan. Sorghum is considered as one of the most important calorie source in the Sudanese diet, future key source of sustainable farming systems and the national economy of Sudan. The paper analyzes sorghum by evaluating its production, consumption and trade trends for a 10-years period (term) for the last three decades (1990 to 2021), and indicates the projections for production, consumption and demand up to 2030.

The paper depended mainly on secondary data collected from relevant sources such as the annual statistics of the central Ministries of Agriculture and Forests for various years. The findings have illustrated that the production of sorghum shows a high annual growth rate during the first (1990s) and the third terms (2010s) in the rain-fed sector. It is clear that, total sorghum consumption in the Sudan rose at an average annual rate lower than the production rate for the whole period of the study. Sorghum is mainly grown for local consumption by small scale holders (60% of quantity produced) in main producing areas, particularly in traditional rain-fed farming, in semi-mechanized and in irrigated agriculture.

The overall trend of the most exports during 1990 -2020 is fluctuated. The period 2000s was the period of oil export from Sudan which was the major source of foreign currency to the government neglecting traditional agricultural exports and the impact was deterioration on agricultural export quantities.

Keywords: sorghum, economics, production, consumption, trade, Sudan

Economic Aspects of Wheat Production and Consumption in Sudan (1990 - 2020)

***Elgilany A. Ahmed[1] (PhD) and Hamid H. M. Faki[2],**
Director of the Agricultural Economics Research and Policy Center of ARC, Sudan
Corresponding author: elgilanya@yahoo.com,

Abstract

This paper emphasizes on a set of high-potential of wheat commodity in Sudan. Wheat is considered as one of the most important calorie source in the Sudanese diet, future key source of sustainable farming systems. The paper analyzes the wheat by examining its production, consumption and trade trends for a 10-years period (term) for the last three decades (1990 to 2021), and indicates the projections for production, consumption and demand up to 2030.

The paper depended on secondary data collected from annual statistics of the central Ministries of Agriculture and Forests, Animal Wealth for various years. The findings have shown that the production of wheat shows a high annual growth rate during the second and the third terms. It is clear that, total wheat consumption in the Sudan rose at an average annual rate higher than the production rate for the whole period of the study. To meet the shortfall between wheat consumption and production, the crop and its flour imports increased. This has exerted a heavy burden on the country's development and creates a negative trade balance due to deteriorating foreign exchange resources.

Therefore, the expected improvement in wheat production needs to maximize the available domestic resources by using modern technologies rather than the expansion of cultivation areas, this will minimize the gap between potential yield and producer' yields.

Keywords: Wheat, Economics, Production, Consumption, Trade, Sudan

Optimizing soil health and wheat crop yield through rice (*Oryza sativa* L.) residue management practices

Ajay Kumar Baheliya[1], Ram Ratan Singh[1], Alok Kumar Pandey[1]

[1] Department of Soil Science and Agricultural Chemistry, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya- (UP) India.

Corresponding author: ajaybaheliya110125@gmail.com

Abstract

The effective management of rice straw is a critical challenge, given its high silica content, rendering it a poor feed for animals. Consequently, farmers often resort to burning or removing residues to facilitate seedbed preparation. Recognizing rice residues as valuable natural resources, a field investigation during the Rabi season of 2020-2021 focused on assessing "Rice (Oryza sativa L.) residue management under Wheat (Triticum aestivum L.) crop in Rice-Wheat sequence." Recycling these residues has been shown to enhance soil physical and chemical properties.

Key variables included recommended NPK application without paddy straw incorporation (T1), incorporation of paddy straw at 5 t/ha alongside Recommended NPK (T2), additional top dressing of nitrogen after straw incorporation (T3), decomposer application with straw incorporation (T4), increased nutrient doses with straw incorporation (T5), and variations of T5 with additional nitrogen top dressing and decomposer application (T6 and T7).

The results indicated that incorporating rice residue at 5 t/ha with 125% of the recommended nitrogen dose, along with phosphorus and potassium, and additional nitrogen top dressing after residue incorporation, along with decomposer application, positively influenced soil properties. Specifically, bulk density decreased, organic carbon percentage increased, and pH and electrical conductivity remained relatively stable, contributing to improved soil health. The incorporation of rice residue with enhanced nutrient doses and management practices positively impacted wheat yield.

Keywords: Rice- Residue, Decomposer, Physical properties of soil, Chemical Properties of soil and productivity of wheat.

Optimization of maize yield by the application of fertilizers, FYM and lime in an acid soil of Himachal Pradesh

Ankita Mohapatra[1] and Raj Paul Sharma[2]

[1]Department of Soil Science, IARI-Hyderabad Hub, ICAR-CRIDA, Hyderabad, 500059, Telangana, India, [2]Department of Soil Science, College of Agriculture, CSKHPKV, Palampur, 176062, Himachal Pradesh, India

Abstract

Amidst the pursuit of augmenting maize yield, imbalanced fertilization and intensive cropping are adversely influencing production potential leading to yield decline or stagnation. Soil acidity also affects the productivity of maize as low pH value has a direct effect on its physiological processes. By evaluating the effects of fertilizers, farmyard manure (FYM), and lime on yield attributes and yield of maize, the study aims to provide insights into the most effective strategies to improve maize yield under acidic conditions.

The experiment was conducted at Palampur, Himachal Pradesh, during *kharif* 2021 with eleven treatments comprising different combinations of 100% NPK, FYM (5 and 10t ha^{-1}), and lime [100% and $1/10^{th}$ lime requirement (LR)], Natural Farming and control, replicated three times in a randomized block design. After the harvest of maize, the data on grain and stover yield, and yield attributes of maize (cob weight, number of grains per cob, test weight, and shelling percentage) was recorded.

The results revealed that the application of fertilizers, with either FYM or lime or their combined application, significantly improved the yield attributes and yield of maize. The highest grain and stover yields of maize were recorded in the treatment comprising 100% NPK + 10t FYM ha^{-1} + lime incorporation @ 100% LR, which was at par with 100% NPK + 10t FYM ha^{-1} + lime incorporation @ $1/10^{th}$ LR in furrow. As a result, there was no significant reduction in yield due to the furrow application of lime at a reduced dose of $1/10^{th}$ of LR. In conclusion, improving maize yield attributes by a balanced soil management approach directly enhances crop production, bolstering food security by ensuring a consistent and ample supply of a staple crop to meet the growing demand for sustenance.

Keywords: Acid soil, FYM, Lime, Maize yield, Yield attributes

Impact of Krishi Bhagya Scheme on the Beneficiary farmers of Karnataka state

Chaithra N.R.[1], Basavaraj Beerannavar [2], Prashant [3]

[1] Research Scholar, Department of Agricultural Extension, UAS, GKVK, Bengaluru

[2] Professor, Department of Agricultural Extension, KSNUAHS, College of Agriculture, Shivamogga, [3] Research Scholar, Department of Agricultural Extension, Indian Agricultural Research Institute, New Delhi

Corresponding author: chaithranr143@gmail.com

Abstract

India being an agrarian country, the total grain production of our country is 285.21 million tons in 2020, but it has to reach nearly 370 million tons by 2050. But the major challenge is to stash away the runoff water for agricultural crops during the dry spell. With this insight, the government of Karnataka has started flagship program, namely "Krishi Bhagya Scheme" a pivotal step towards achieving sustainability of rain-fed agriculture. The scheme had been extended to Malnad areas including Shivamogga district. The study was conducted in Karnataka state with the sample size of 120 farmers consisting of 60 beneficiaries and 60 non-beneficiaries from Shivamogga district. The predominant findings of the study revealed that change in cropping intensity by 47 per cent, majority of the beneficiaries (53.33%) had a medium knowledge, nearly 41.66 per cent have cultivated four to six crops that is moderate cropping pattern, 51.67 per cent of beneficiaries had high crop intensity, maximum (55.00 %) beneficiaries had an labour days of 100 to 200 days, and prominent beneficiaries 53.33 per cent had Agriculture+ Horticulture + Animal husbandry as an enterprise combination, and the average increased yield of paddy (20.46 %), vegetables (18.77%), maize (12.68 %), and Arecanut (14.76 %). This remarkable increase in the yield due to the reasons that availability of the farm pond water during the critical stages of the crops, which impacted on the crop to reach better yield potential. The anecdotal evidence from this research will suggest policy makers a slew of appropriate strategies and interventions can be extended to other parts of the country to improve farmers income and leading to sustainable water usage.

Key words: Krishi Bhagya Scheme, Impact, Income.

Bio-security: Key arena for advancing shrimp aquaculture productivity and sustainability

M.Poornima, K.Nalayeni, R.Vidya, J.J.S. Rajan and M.S. Shekhar
ICAR-Central Institute of Brackishwater Aquaculture, Chennai, Tamil Nadu, India
Corresponding author: M.Poornima@icar.gov.in

Abstract

Aquaculture, driven by technological advancements and innovative developments, is experiencing rapid growth worldwide. However, ensuring sustainability in production, and protecting the environment, are crucial considerations in shrimp production. However, the intensification of shrimp farming has led to the emergence of diseases, posing significant challenges to the growth of aquaculture. Disease outbreaks in aquaculture can result in substantial production losses, effect socio-economic development and rural livelihoods and environmental impacts. Therefore, diseases have become one of the most formidable obstacles faced by the shrimp aquaculture industry.

Consequently, the sector is struggling to manage the socio-economic burden of diseases due to significant costs for disease management. To address these challenges, biosecurity measures are crucial. Biosecurity involves implementing appropriate measures to minimize the spread of pathogens, thereby mitigating adverse impacts. It focuses on managing the health of aquatic animals and reducing health risks associated with production. Despite extensive efforts by policy makers, industry players, academia, and development institutions, the inadequate implementation of biosecurity practices remains the primary challenge hindering global aquaculture development over the past three decades.

Addressing aquatic animal health issues has become an urgent requirement for the sustainable growth of aquaculture, particularly through proactive programs. Therefore, this article highlights the importance of the adoption of various biosecurity measures which is crucial in order to have a substantial influence on enhancing efficiency, profitability, and sustainability for the future progress of aquaculture.

Key words: Aquaculture, Biosecurity, Diseases, Management, Pathogens, Shrimp

Seed priming and foliar application of Herbal Kunapajala improved growth, productivity and profitability of late sown wheat

Okram Ricky Devi[1,2], Omvati Verma[2], Nayanjyoti Ojha[1] and Bibek Laishram[1]
[1]Assam Agricultural University, Jorhat-785013, Assam
[2] G. B. Pant. University of Agriculture & Technology, Pantnagar-263145, Uttarakhand
Corresponding author: *rickydeviokram@gmail.com*

Abstract

Crop growth and productivity of late sown wheat is affected by low temperature stress which leads to poor emergence that restricts vegetative growth and high temperature shortens the duration of crop phenophase resulting low yield. Therefore, to evaluate the effect of herbal kunapajala (KJ) on growth and productivity of late sown wheat, a field experiment was conducted during 2020-21 at GBPUA&T, Pantnagar.

It comprised of 14 treatments viz.; T1: No seed priming + 100% RDN (recommended dose of nutrients), T2:Hydropriming + 100% RDN, T3:10% KJ priming + 100% RDN+ foliar application of 10% KJ, T4:10% KJ priming + 75% RDN+ foliar application of 10% KJ, T5:10% KJ priming + 50% RDN+ foliar application of 10% KJ, T6: 10% KJ priming + no fertilizer+ foliar application of 10% KJ, T7: 25% KJ priming + 100% RDN+ foliar application of 10% KJ, T8:25% KJ priming + 75% RDN+ foliar application of 10% KJ, T9: 25% KJ priming + 50% RDN+ foliar application of 10% KJ, T10: 25% KJ priming + no fertilizer+ foliar application of 10% KJ, T11: 50% KJ priming + 100% RDN+ foliar application of 10% KJ, T12: 50% KJ priming + 75% RDN+ foliar application of 10% KJ, T13: 50% KJ priming + 50% RDN+ foliar application of 10% KJ and T14: 50% KJ priming + no fertilizer+ foliar application of 10% KJ in randomized block design with three replications.

The results revealed that among all the treatments T3 improved growth, productivity and economic profitability of late sown wheat.

Keywords: Seed priming, Kunapajala, Wheat, growth, Hydropriming

Precision Agriculture for a Sustainable Tomorrow: Soil and Water Conservation in Crop Management

Paras Hirapara[1], H. D. Rank[2], H. V. Parma[3]

Dept. of Soil and Water Conservation Engineering, College of Agricultural Engineering and Technology, Junagadh Agricultural University, Junagadh (Gujarat)

Corresponding author: *parashirapara704@gmail.com*

Abstract

With the world's population continuing to rise, there is an increasing need for food production, which calls for a paradigm change toward sustainable farming methods. It is vital to create ways that increase output while protecting the environment because traditional farming practices are facing serious challenges from climate change. With a focus on the critical role that soil and water conservation play, research study explores the many advantages of sustainable crop management.

Agroforestry, cover crops, and precision irrigation are a few techniques that farmers can implement to reduce soil erosion, improve water efficiency, and support biodiversity. These methods preserve natural resources for coming generations while simultaneously increasing crop yields. The significance of soil health in sustainable agriculture is also clarified by the research. Long-term production can be sustained by preserving soil fertility and structure through the use of conservation tillage and organic farming techniques. Furthermore, by integrating contemporary technology like data analytics and remote sensing, farmers can make well-informed decisions that maximize resource efficiency and minimize environmental damage.

Communities can strengthen livelihoods, increase food security, and become more resilient to climate change by providing farmers with the knowledge and tools they need to implement these practices. In summary, sustainable crop management—which is based on methods for conserving soil and water becomes apparent as a vital strategy for satisfying the world's growing need for food production.

Key words: Crop management, Water conservation, Climate change adaptation, Precision irrigation, Remote sensing, Resource optimization

Evaluation of genetic variability, heritability and genetic advance in aromatic rice germplasm in Odisha

Shakti Prakash Mohanty[1], Binod Kumar Jena[2], Saumya Ranjan Barik[1], Arpita Moharana[1], Swastideepa Sahoo[1], Sushree Sangeeta[1] and Sharat Kumar Pradhan[3]

[1] ICAR-National Rice Research Institute, Cuttack, Odisha, India, [2] Department of Genetics and Plant Breeding, Institute of Agriculture, Visva-Bharati, West Bengal, India

Indian Council of Agricultural Research, New Delhi, India

Corresponding Author: evenpunk22@yahoo.co.in

Abstract

Continuous research in rice for solving the contemporary problems is most vital to maintain the global food security. In this study 117 short grain aromatic rice germplasm have been evaluated for estimating the genetic variations present for 11 traits of yield and yield attributing traits. All the short grain aromatic rice germplasm studied possessed considerable amount of variations for all the studied traits of yield and its component traits. Plot yield, number of grains per panicle, plant height, fertility percentage and flag leaf area exhibited higher magnitude of genetic variation.

Selection on phenotypic value was effective for majority of traits as there was little difference between PCV and GCV, but the low values of GCV for days to 50% flowering, panicle number, panicle length and fertility percentage indicated limited scope for improvement of these traits. A moderate to high degree of heritability with moderate to high genetic gain for plant height, grains per panicle , flag leaf length, flag leaf area, grain yield per plant and plot yield indicated the presence of additive gene effects, hence selection based on phenotypic value would be effective. The trait panicle length showed high heritability value with low genetic gain indicated the presence of both additive and non-additive gene effects and low heritability estimates with low genetic gain for traits like panicle number, days to 50% flowering, fertility percentage, 100-grain weight suggested that dominance and epistatic gene effects might be operating in the inheritance of these traits.

Keywords: Genetic variability, heritability, genetic advance, coefficient of variation, rice

The need, impact and emerging trends of zinc application and bio-fortification – A review

Dr. Shama Zaidi
Aries Agro Limited

Abstract

Micronutrient plays a specific role in plant, animal and human metabolism and their deficiency cannot be mitigated by substitution of other elements. Zinc is a vital trace mineral that the body needs in small amounts, and is required by almost 100 enzymes in the body to perform various vital chemical reactions. Zinc is a divalent cation which is not synthesized within the human body and hence needs to be taken from outside to maintain adequate levels. Zinc deficiency is commonly seen in developing regions that is attributable to malnutrition or is found to be associated with aging and many chronic illnesses.

About 17% of the global population and about 30% population in South Asia is at risk for inadequate zinc intake. The vulnerable populations include infants, young children, and pregnant and lactating women. In India, about 47.9% children show nutritional stunting due to Zinc deficiency as against the global average of 33%.

There is a very strong correlation between soil Zn status and human Zn deficiency level. The available Zn in Indian soils ranges from 0.01 to 52.9 mg/kg. Initially Zn deficiency was observed particularly in the rice and wheat belts of the country, but now is seen across all crops and cropping systems. Soils with a poor Zn status, is unable to supply the requisite amount required for good health, which is 40–50 ppm. Hence, if cereals are cultivated on Zn-deficient soils, then it becomes absolutely necessary to maintain optimum required levels of Zn in the soil especially during the critical growth stages.

The bio-fortification of micronutrients at specific and critical growth stages may contribute toward grain mineral enrichment and enhanced yield by improving their availability. Of the several strategies developed, soil application with foliar feeding is the best for grain enrichment. Bio-fortified crops are also a feasible means of reaching rural populations who may have limited access to diverse diets or other micronutrient interventions. Bio-fortification puts a solution in the hands of farmers, combining the micronutrient trait with other agronomic and consumption traits that farmers prefer.

Keywords: Micronutrients, Bio-fortification, Foliar application, Deficiency, Soil status

Optimizing Cowpea productivity in Rain-fed Coconut garden through Sustainable Intensification

Vanam Joshna[1] and Sharu S R[2]

[1] Ph.D Scholar, Department of Agronomy, IARI Mega University Hyderabad Hub, ICAR-CRIDA, Hyderabad, Telangana, India, [2] Assistant Professor, Department of Agronomy, College of Agriculture, Vellayani, Kerala Agricultural University, Trivandrum, Kerala, India

Abstract

Sustainable intensification is an approach using innovations to increase productivity on existing agricultural land with positive environmental and social impacts. This approach in cowpea can be possible through seed treatment and foliar application of nutrients by utilizing the space in coconut garden. Being a nutrient rich crop and having the ability to grow well in scarce rain-fed areas, cowpea is well suited for intercropping in rain-fed coconut garden.

The field experiment was conducted at Coconut Research Station, Balaramapuram, Kerala during *rabi* 2021-22. It was laid out in RBD, with 18 treatment combinations replicated thrice. It consisted of three seed treatments each @ 20 g kg^{-1} seed [(s_1- *Trichoderma* sp. (KAU isolate), s_2- PGPR Mix II (Microbial consortium of *Pseudomonas flourescens* and *Bacillus subtilis*), s_3- control (no seed treatment)] and six levels of foliar application of nutrients at 40 DAS [f_1 - urea 2%, f_2 - DAP 2%, f_3 - KCl 2%, f_4 - urea 2% *fb* DAP 2%, f_5- KCl 2% + DAP 2%, f_6- control].

Results revealed that higher crude protein content of grain was registered in s_2 however, lower was recorded in s_3. Treatment s_2 also recorded higher total N, P and K uptake. Higher crude protein content of grain was recorded in f_4. Treatment f_4 also registered higher total N and P uptake while f_5 recorded higher total K uptake. Enhancement in grain yield was to the tune of 23.14% and 15.43% in s_2 compared to s_3 and s_1 respectively. Treatment f_4 resulted in a yield increase of 11.20%, 17.01%, 26.18%, 7.5% and 37.16% over the treatments, f_1, f_2, f_3, f_5 and f_6 respectively. Incorporating seed treatment PGPR Mix II and foliar application of urea 2% *fb* DAP 2% in cowpea enhances grain quality and yield. These sustainable intensification practices demonstrate potential for optimizing productivity and resource efficiency in rain-fed coconut gardens.

Keywords: Sustainable intensification, Foliar application, Seed treatment, PGPR, Cowpea, Intercropping

Influence of planting techniques and integrated nutrient management on organic fractions

G. Naveen Kumar[1], P.K. Singh[1], R.K. Naresh[1]

[1]Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh

Corresponding author: gundlapallinaveen26@gmail.com

Abstract

This study investigates the intricate interplay between planting techniques and integrated nutrient management on various organic fractions within the soil. The research encompasses a comprehensive field experiment conducted during kharif 2019, employing a split plot design to assess the impact of different planting techniques *viz*. (M1-Reduced Tillage-Transplanted Rice (RT-TPR), M2-Conventional Tillage-Transplanted Rice (CT-TPR), M3-Furrow Irrigated Raised Beds (FIRB), M4-Unpuddled-Transplanted Rice (UP-TPR)) as main plot treatments. Concurrently, various integrated nutrient management strategies, (S1-Control, S2-100% NPK Chemical fertilizer, S3-100% N (FYM), S4-50% NPK + 50% N (FYM), S5-75% NPK + 25% N (FYM), S6-100% NPK + 25% N(FYM)) as subplot were applied to investigate their synergistic effects on particulate organic carbon, microbial biomass and total organic carbon.

Results revealed that CT-TPR, combined with chemical fertilizer and organic nitrogen from FYM, planting technique RT-TPR, emphasizing reduced tillage and residue retention, enhanced particulate organic carbon (POC) at the surface soil, while the CT-TPR exhibited the lowest POC content overall. RT-TPR led to higher total organic carbon (TOC) content due to minimized soil disturbance, preserving organic matter. Applying 100% nitrogen from farmyard manure (FYM) increased TOC. RT-TPR and FYM application significantly increased microbial biomass carbon, enhancing soil health.

The study contributes valuable insights into sustainable rice cultivation by elucidating the interactions between establishment methods and nutrient management on organic fractions. The findings have implications for optimizing agricultural practices to enhance soil health, promote sustainable rice production, and mitigate environmental impacts associated with conventional farming practices.

Key words: Planting techniques, Integrated nutrient management, Organic fractions, Sustainable agriculture

Fields of the Future: Building Agricultural Resilience to Climate Change

Jaykumar B. Gajera [1] and Sunny V. Mavani[2]

[1] Research Scholar, Department of Agronomy, [2] Research Scholar, Department of Genetics and Plant Breeding, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat)

Corresponding author: jay.gajera@jau.in

Abstract

These paper underscores the significance of agricultural resilience in addressing the impacts of climate change. The threats posed by extreme weather events and the depletion of resources to crop yields and food security are substantial. To effectively address the increasing global demand for food while minimizing environmental impact, it is imperative to implement comprehensive strategies. These encompass the adoption of climate-resilient crop varieties, the promotion of sustainable farming techniques, and providing support for vulnerable communities.

Crucial for meeting sustainable food demand are innovative solutions like precision farming, agroforestry, smart irrigation systems, and practices aligned with circular economies. Practices such as organic and regenerative agriculture play a vital role in enhancing soil health, water conservation, and biodiversity.

Additionally, technological advancements like precision agriculture, smart irrigation systems, and the application of artificial intelligence and machine learning contribute significantly to bolstering agricultural resilience. Successful outcomes hinge on collaborative efforts among researchers, farmers, and policymakers to develop and implement resilient farming practices that can effectively address the escalating global food demand in a sustainable manner.

Key words: Fields of the Future, Sustainable Practices, Adaptive management strategies, Weather patterns, Data analytics, Internet of Things (IoT), Resilient future

Evaluation of Bio-pesticides against incidence and intensity of exotic Whitefly complex Rugose spiralling whitefly, *Aleurodicus rugioperculatus* Martin and Bondar's nesting whitefly *Paraleyrodes bondari* Peracchi in coconut (*Cocos nucifera* L.) under low, medium and high grades.

J. Mohitha Reddy[1*], N.B.V Chalapathi Rao[2]

[1]Ph.D Scholar (Department of Entomology), [2] Principal and Head Scientist, College of Horticulture, Venkataramannagudem, Dr. YSR Horticultural University

.

Corresponding author - mohithareddy1997@gmail.com

Abstract

In the recent years, coconut crop in India have experienced many new invasive pests, particularly whiteflies. In the absence of native natural enemies and effective management options to tackle pests, farmers rely extensively on indiscriminate application of synthetic pesticides to control the pest which may lead to rapid build-up of resistance in the target pests, resulting in secondary pest outbreaks. Use of bio-pesticides can be an effective alternate to chemical insecticides as they are economical, eco-friendly than conventional pesticides and their usage does not lead to resistance build-up in target pests and are safer for human health.

The efficacy of certain bio-pesticides against RSW and BNW was tested under field conditions at HRS, Ambajieta under 3 grades according to rating scale (LOW <10 spirals/ leaflet, MEDIUM 10-20 spirals/ leaflet and HIGH 20 spirals/ leaflet). Among the various tested bio-pesticides, in all the three grades (low, medium and high) spraying of *I. fumosorosea* NBAIR pfu-5 @ 5 ml/L was found to be superior followed by Azadirachtin 10,000 ppm @ 1 ml/L.

In Low grade, incidence and intensity of whitefly complex was 5.90 % and 5.20 % respectively after 28 DAS. *I. fumosorosea* @ 5 ml/L was found to be effective to some extent in medium grade with incidence of 22.09 % and intensity of 25.25 % after 42 DAS followed by Azadirachtin with incidence of 25.91 % and intensity of 27.89 % after 42 DAS.

Under high grade sprayings were found to be completely ineffective when compared to low and medium grades. In high grade, *I. fumosorosea* @ 5 ml/L recorded incidence of 64.72 % and intensity of 69.34 % followed by Azadirachtin @ 1 ml/l with incidence and intensity of 68.23 % and 73.68 % respectively after 42 DAS.

Key words: Rugose spiralling whitefly, Bondar's nesting whitefly, Coconut, Bio-pesticides.

Screening of bacterial endophytes for plant growth promotion and seedling growth in millets

Rajesha G., Das I. K., P. G. Padmaja, Ganapathy K. N., Sooganna and Tara C. Satyavathi
ICAR-Indian Institute of Millet Research, Rajendranagar, Hyderabad, Telangana

Abstract

Millets are important food, feed, fuel and fodder crops cultivating across India and world. For getting good production and productivity of millets, early vigor and seedling growth stage is very important. To improve the early vigor in millets, the millets endophytes have been investigated to identify the best endophytes for plant growth promotion as well as early seedling vigor. Total of 228 bacterial endophytes have been isolated from sorghum, finger millet, little millet and kodo millet; and tested for plant growth promotion activates.

Out of 47 bacterial endophytes, 26, 34, 6 and 7 number reported positive for Ammonia production, Phosphate solubilisation, Siderophore production and HCN production respectively. The selected bacterial endophytes were identified through molecular characterization by using 16S rRNA gene sequence. The amplified endophytes at 560bp were confirmed with sequencing. The best performing 40 isolates of bacterial endophytes based on the *in-vitro* studies of plant growth promotional activities were selected for testing for plant growth promotion in sorghum, finger millet, kodo millet and little millet under *in-vivo*.

It has been recorded that, maximum plant growth was reported with endophytes of specific crops. The crop based endophytes showing the maximum seedling root and shoot length of respective crops then compare with other millet crops. Seed treatment with elite bacterial endophytes was carried in millets for effective seedling length.

The maximum seedling length of 64.32cm (SEB15), 37.96cm (FMEB13), 35.39 cm (KMEB12) and 48.61cm (LMEB40) in Sorghum, Finger millet, Kodo millet and Little millets respectively compare to control.

Key words: Endophytes, Millets, Growth promotion

Sustainable approach for Capsicum cultivation using Organic amendments – A case study

Simhi Samyukta S M[1] and Viji M M[2]

[1]Ph.D Scholar, [2]Professor, Department of Plant Physiology, College of Agriculture, Kerala Agricultural University, Trivandrum.

Abstract

Sustainable agriculture frequently embodies the sustainment of the economic viability of agriculture systems. Use of organic amendments is one of the most eco-friendly ways of farming. Biochar improves the physical, chemical, biological as well as nutritive status of the soil and sequestering atmospheric carbon into the soil. Biochar is a carbonaceous material obtained by the pyrolysis of feedstocks.

Positive impacts associated with biochar includes increased soil microbial activities, enhanced soil nutrient uptake and carbon sequestration. Microbiome is also a key player in sustainable agriculture. They induce array of responses such as producing plant growth promoting substance, nutrient cycling, heavy metal chelation etc. Capsicum is rich in bioactive compounds that are correlated with several health benefits. In a pot culture experiment, bell pepper (*Capsicum annuum*) variety 'California Wonder' was treated with biochar and biofertilizers. Biofertilizers studied includes *Azospirillum*, Vesicular Arbuscular Mycorrhizae, *Piriformospora indica* and their combinations with biochar. Biochar and biofertilizers were given as direct soil application during transplanting.

Results revealed that biochar and biofertilizers improved the growth parameters such as plant height, leaf area index, root volume as well as dry matter production. Yield attributes like fruit weight, yield per plant as well as fruit's antioxidants capacity were also found to be higher under organic amendments application. Biochar also significantly increased the organic carbon content of the soil. Among the treatments studied, the combined application of biochar and VAM fungi increased the efficiency of bell pepper plants proving to be a sustainable approach for vegetable cultivation and improving soil health.

Keywords: Azospirillum, Vesicular Arbuscular Mycorrhizae, Piriformospora indica, biochar, soil health

Effect of Various Levels of Chickpea Magic on Nodulation, Yield and Economics of Chickpea (*Cicer arietinum L.*).

Vidya, V. S[1]., Rudragouda, F. C. [2] and Bhavya, M[3].

[1&3] Ph. D. Scholar, [2]Assistant professor, Department of Agronomy, KSNUAHS, Shivamogga-Karnataka.

Corresponding author.: vidyavs1611@gmail.com,

Abstract

A field experiment was carried out during *Rabi* season of 2021-22 at ZAHRS, Babbur farm, Hiriyur, Chitradurga, to know the "Effect of various levels of chickpea magic on growth and yield of chickpea (*Cicer arietinum* L.)". The experiment was laid out in RCBD with 9 treatments replicated thrice. The treatments include foliar application of various levels of chickpea magic and DAP sprayed at 45 DAS with or without FYM along with the RDF.

The results concluded that foliar application of 1 per cent chickpea magic at 45 DAS along with 100 per cent RDF (13:25:25 kg NPK + FYM @ 7.5 t/ha) recorded significantly higher number of nodules and effective nodules plant^{-1} at 45 DAS (31.59 and 25.69, respectively), number of pods plant^{-1} (47.03), pod yield plant^{-1} (28.24 g) and 100 seed weight (24.66 g). The better values of these indices in treatment resulted in higher seed yield (18.53 q ha^{-1}) and haulm yield (26.96 q ha^{-1}) over the farmers practice and 1 per cent chickpea magic alone. Further, higher protein content in seeds (23.62 %) as well as higher nitrogen, phosphorus and potassium and zinc uptake by chickpea (95.25, 14.98, 82.01 kg ha^{-1} and 162.91 g ha^{-1}, respectively) was also noticed in the above said treatment. The higher net returns (₹ 58,045 ha^{-1}) and benefit cost ratio B: C ratio (2.61) were recorded in treatment received 100 per cent RDF+ FYM along with foliar spray of 1 per cent chickpea magic at 45 DAS.

The magnitude of increase in yield and yield attributing characters with foliar application of 1 per cent chickpea magic along with 100 per cent RDF was to an extent of 16.99 per cent in number of pods plant^{-1}, 25.95 per cent in pod yield pant^{-1} and 39.63 per cent in seed yield over farmers practice treatment without chickpea magic application.

Key words: Chickpea, Chickpea magic, Nodules, Effective Nodules, Yield and Economics

Sustainable way to Protect and Enhance the Crop health through Proper IPM practices in rice (*Oryza sativa* L.)

Sampath Kumar. M[1], Ambethgar. V [2], Anandhi. P [3], Suresh. R [4] and Niruba. D[5]

[1] Agricultural Entomologist, IFC Project, Sugarcane R&D Centre, EID PARRY (India) Ltd., Karur, Tamil Nadu, [2] Professor and Head (Agrl. Entomology), ADAC&RI, TNAU, Trichy [3] Assoc. Prof., (Agrl. Entomology), TRRI, TNAU, Aduthurai, [4] Assoc. Prof., (Genetics and Plant Breeding), Dept. of Rice, TNAU, Coimbatore, [5] Agrl. Entomologist, IFC Project, Sugarcane R&D Centre, EID PARRY (India) Ltd., Cuddalore, Tamil Nadu

Corresponding author: sampathkumar8699@gmail.com

Abstract

Rice (*Oryza sativa* L.) is life for more than half of the world population, intertwined with food and human culture. Ninety percent of the rice is produced and consumed in Asia. The country's population is increasing every year which also increases demand for rice production. Rice cultivation largely inflicted by insect pests more than 200 species which is a major bottleneck for production and productivity in rice. Integrated Pest Management (IPM) is endorsed as the future standard for crop protection worldwide which is the holistic concept that integrates preventative and curative measures. Amongst the cultural, mechanical & biological measure which all play a vital role in managing the insect pests in Rice ecosystem. According to this, the study conducted at Tamil Nadu Rice Research Institute, TNAU, Tamil Nadu during 2022 – 2023, entitled with "Studies on Host Plant Resistance against Yellow Stem Borer, *Scirpophaga incertulas* (Walker) (Crambidae: Lepidoptera) in Rice" with the aim to identify the resistant rice cultivars against stem borer.

From this study, the exact aim of resistant rice germplasm against stem borers were identified which are all suggested to use in breeding program in future to develop new varieties with resistance & tolerance character. Moreover, we recorded the interesting fact from this study in which where all the IPM measures applied except chemical insecticides in correct time and correct way that shown better result by reducing insect pest incidence and increased the yield of the rice crop. One more unique and important thing was noted that the application of proper IPM measures and chemical free rice ecosystem which increased the population of natural enemies like parasitoids and predators.

According to this study, the use of IPM practices especially using Biocontrol agents and avoiding insecticides in a proper way is the tool to achieve the sustainable crop health management as well as environment for achieving the Food Security, not only in Rice, in other crops too. Moreover, by supporting farmer to make them as farmer cum entrepreneur through producing BC agents which will be very useful to them and the farming community in a sustainable manner.

Key words: Rice, Insect pest, IPM practices, Natural enemies, BC agents, Crop health, Entrepreneur

Nano Pesticides in Insect Pest Management: A Sustainable Approach for Enhanced Crop Protection.

G. Anil kumar

[1] Ph.D Scholar, Department of Entomology, Agricultural College, Bapatla (ANGRAU)

Corresponding author: anilgadde1997@gmail.com

Abstract

Insects play a vital role in ecosystems, yet their impact on agriculture, human health, and economic stability cannot be overlooked. Traditional chemical pesticides have been extensively used to control insect populations, but their indiscriminate use has led to environmental and health concerns. In response to the challenges posed by conventional pesticides, nanotechnology has emerged as a promising solution.

Nano Pesticides, defined as formulations employing nanotechnology in the 1-100 nano meter range, offer a revolutionary approach to insect pest management. The primary goal of Nano Pesticides is to enhance the efficacy of active ingredients while minimizing environmental impact. These formulations, utilizing nanomaterials such as metals, metal oxides, and nano clays, exhibit improved solubility, stability, and controlled release of active ingredients. The reduced quantities of active ingredients required contribute to decreased pollution and environmental contamination. Furthermore, the nano-sized particles offer systemic properties, uniform leaf coverage, and improved soil properties, making them a constructive choice for sustainable agriculture. This abstract explores the historical evolution of nanotechnology, emphasizing its significant milestones and applications in agriculture. Nanoparticles, encapsulations, nano emulsions, and nano gels are among the various formulations discussed, showcasing their potential in insect pest management.

Case studies highlight the effectiveness of specific Nano Pesticides, such as poly-lactic acid encapsulated Abamectin nanoparticles and silica-fipronil formulations, against targeted pests. While Nano Pesticides bring several advantages, potential risks must be considered. Health risks associated with dermal exposure and environmental concerns regarding nanoparticle accumulation in soil, water, and plants are discussed. Striking a balance between the benefits and risks, Nano Pesticides offer a sustainable and environmentally friendly alternative to traditional pesticides, aligning with the global push for precision agriculture and reduced environmental impact.

This abstract provides valuable insights into the potential of Nano Pesticides, contributing to the ongoing discourse on sustainable insect pest management practices.

Keywords: Nano Pesticides, nanotechnology, insect pest management, sustainable agriculture, environmental impact, crop protection.

Harnessing Biochar for Agricultural Sustainability: Cultivating Resilient and Eco-Friendly Farming Practices

Navdeep Singh Bhati[1], Deshraj Meena[1] and Titiksha Bohara[2]

[1]Ph. D. Research Scholar, Department of Soil Science & Agricultural Chemistry, College of Agriculture, S. K. Rajasthan Agriculture University, Bikaner (Rajasthan)

[2]M.Sc. Research Scholar, Department of Fruit Science, College of Horticulture, Junagadh Agricultural University, Junagadh (Gujarat)

Email*: navdeepbhati432@gmail.com

Abstract

Biochar, also referred to as Agrichar, is a carbon-rich substance created through the gradual pyrolysis process, involving the controlled heating of organic materials within a limited oxygen supply, typically at temperatures ranging from 250 to 700°C. Its distinctive feature lies in its ability to sequester carbon for extended periods, exhibiting greater chemical and physiological stability compared to its carbon source, thereby making its conversion back to CO_2 more challenging. With an enlarged surface area, negative surface charge, and high charge density, biochar exhibits heightened potential for absorbing cations and effectively retaining and exchanging nutrients with the soil environment, including interactions with microbes and plant roots. Moreover, biochar plays a crucial role in stabilizing biomass and native soil organic matter, contributing to improved soil aeration, increased microbial activity, and nitrogen immobilization, ultimately reducing emissions of significant greenhouse gases. Beyond its applications in agriculture, biochar significantly contributes to sustainable agricultural production and climate change mitigation.

The benefits of biochar amendments extend to enhancing nutrient availability, particularly for phosphate and nitrogen, across diverse soil types. Its positive impact on soil fertility includes improvements in microbial activity, reduced bulk density, increased nutrient and water retention capacity, and the preservation of soil organic matter. Notably, the pyrolysis of local waste materials into biochar presents an intriguing avenue to strengthen the interconnectedness between plants, soil, and the environment. This aspect is particularly valuable for small-scale farming, where the produced biochar can be utilized in fields to enhance crop yields. Consequently, biochar emerges as a valuable soil supplement, contributing significantly to the realization of sustainable agriculture and environmental objectives.

Keywords: Sustainable, Waste management, Greenhouse gases, Surface area and Nutrients.

Rethinking Residues: A Sustainable solution for Thriving soils and abundant harvests

Aman Verma[1], R. K.Doharey[2], Amrit Warshini[3], Kapil Verma[4]
[1,3Ph].D. Research Scholar, 2Professor, [4]M.Sc. Scholar
[1,2,3,4] Acharya Narendra Deva University of Agriculture and Technology,
Kumarganj, Ayodhya, U.P.
Corresponding author: vermaman798577@gmail.com

Abstract

Traditional agricultural practices have long considered crop residues as waste, leading to their removal through tilling. However, this approach has resulted in deteriorating soil health, heightened erosion, and increased dependence on synthetic inputs, posing threats to both food security and environmental sustainability. This abstract advocates for a paradigm shift, redefining residues as invaluable resources capable of revolutionizing agricultural practices.

Crop residues, comprising leaves, stems, and roots post-harvest, extend benefits beyond nutrient replenishment. Serving as a protective blanket, they shield soil from erosion caused by wind and water, enhancing soil structure and water retention. This fosters resilient crops with reduced irrigation needs. Additionally, residues support a robust microbial community, pivotal for decomposing organic matter, releasing nutrients, and promoting soil fertility. This diminishes reliance on synthetic fertilizers and pesticides, aligning with sustainable and environmentally friendly agriculture.

Embracing crop residue management transcends leaving residues on the field; it involves adopting practices to maximize their impact. Minimizing tillage is crucial to preserve soil structure and keep residues close to the surface. Techniques like mulching and cover cropping further amplify benefits. Mulch suppresses weeds, conserves moisture, and moderates soil temperature, while cover crops add nitrogen, suppress weeds, and alleviate compaction. These practices synergize to create a virtuous cycle of soil health, resulting in increased yields, improved crop quality, and reduced environmental impact.

Rethinking residues transcends a mere agricultural practice; it embodies a philosophy embracing a holistic approach to food production. Recognizing the interconnectedness of soil health, environmental sustainability, and food security, this abstract advocates for embracing this shift. By doing so, we can unlock the transformative potential of crop residues, paving the way for a future where agriculture nourishes both the land and its people.

Keywords: Crop residue management, soil health, sustainable agriculture, erosion control, cover crops etc.

Impact of cluster frontline demonstrations in productivity enhancement and dissemination of pigeon pea production technology in Dholpur, Rajasthan

Dinesh Kachhawa, Navab Singh, Shivmurat Meena, Madho Singh
Laxman Prasad Balai and Lokendra Berwal
Krishi Vigyan Kendra, Dholpur

Abstract

The 133 cluster front line demonstrations on pigeon pea were conducted by krishi Vigyan Kendra, Dholpur, Rajasthan during Kharif season of 2019-20 and 2020-21. The critical inputs were identified in exciting production technology through farmers meetings and group discussion. Improved crop management practices recorded the highest mean seed yield of 16.67 q ha-1 which was 18.77 per cent higher than the yield obtained with farmers practice (14.30 q ha-1).

The yield levels were considerably lower under local practices because of considerable variation in the extent of adoption of recommended technology depending upon the amount of risk involved in terms of cost, convenience, skill and knowledge about the concerned practice. Average extension gap, technology gap and technology index of pigeon were found 2.67 q ha-1, 4.52 q ha-1 and 24.50 per cent respectively. Average benefit cost ratio was found higher throughout the study in pigeon pea i.e 2.89.

Variations in the technology gap and index percentage were observed due to variation in agro-climatic parameters, soil fertility, biotic stresses, and socio-economic status and management practices. The productivity was better over local practice under demonstrations. Hence, pulses production and protection technology have a broad scope for increasing the area and production of pulses at each and every level i.e., Farmers, State and National level.

Key words: Impact, Cluster frontline demonstrations, Productivity enhancement, Dissemination, Pigeon pea production technology

Index

Advisory Committee

Dr. P. Chandra Shekara
Director General MANAGE, Hyderabad

Dr. Joanna Kane-Potaka
DDG Strategy, Engagement & Impact, IRRI

Dr. Victor Afari-Sefa
Global Research Program Director & Acting DDG Research ICRISAT, Hyderabad

Dr. Samarendu Mohanty
Asia Regional Director, International Potato Centre CIP Asia Regional Office, New Delhi

Mr. Arun Baral
CEO, HarvestPlus, USA

Dr. Virender Kumar
Principal Scientist & Deputy Head, Sustainable Impact Department, IRRI

Dr. Sudhanshu Singh
Director - IRRI South Asia Regional Centre (ISARC)

Mr. Ravinder Grover
Asia Coordinator, Harvest Plus

Scientific Coordinating Committee

Dr. Veenita Kumari
Deputy Director (Gender Studies) MANAGE, Hyderabad

Dr. Sugandha Munshi
Senior Associate Scientist & Lead Specialist, Sustainable Impact Platform, IRRI

Dr. Sampriti Baruah
Regional Research Specialist - Asia, CIP, New Delhi

Dr. R. Padmaja
Principal Scientist, Socialogist, Gender & Nutrition Research, ICRISAT, Hyderabad

Dr. Sreenath Dixit
Principal Scientist & Strategic Advisor, ICRISAT, Hyderabad

Dr. Mahalingam Govindaraj
Senior Scientist, Harvest Plus

Dr. Parminder Virk
Senior Advisor, Harvest Plus

Conference Coordinators

Dr. K. Naresh
Acadamic Associate, MANAGE, Hyderabad

Dr Shirisha Junuthula
MANAGE Fellow, MANAGE, Hyderabad

Ms. S L Kameswari
Consultant, MANAGE, Hyderabad

Ms. Pragati Shukla
Consultant, MANAGE, Hyderabad

Knowledge Partners

IRRI International Rice Research Institute · CGIAR · ICRISAT International Crops Research Institute for the Semi-Arid Tropics · CIP International Potato Center · CGIAR · HarvestPlus Better Crops / Better Nutrition

MANAGE

National Institute of Agricultural Extension Management (MANAGE)
(An Autonomous Organization of Ministry of Agriculture & Farmers Welfare, Govt. of India)
Rajendranagar, Hyderabad-500030, Telangana, India
Tel: +91 (0) 40 24594509
Website: www.manage.gov.in; e-mail: helpline@manage.gov.in

MANAGE
मैनेज

National Institute of Agricultural Extension Management (MANAGE)
(An Autonomous Organization of Ministry of Agriculture & Farmers Welfare, Govt. of India)
Rajendranagar, Hyderabad-500030, Telangana, India
Tel: +91 (0) 40 24594509
Website: www.manage.gov.in; e-mail: helpline@manage.gov.in